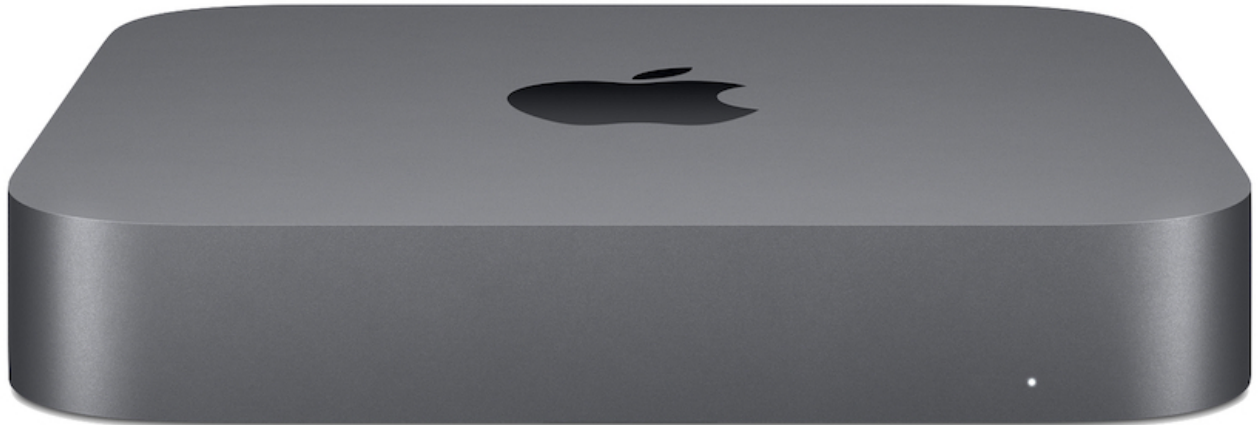


Mac mini (2018) Overview

Mac mini (2018) Overview



Features:

- Finish: Space Gray
- Processor: 3.6GHz four-core Intel Core i3, 3.0GHz six-core Intel Core i5, configurable to 3.2GHz six-core Intel Core i7
- Storage: 128GB, 256GB, 512GB, 1TB, or 2TB of onboard SSD storage
- Memory: 8GB of 2666MHz DDR4 SO-DIMM, configurable to 64GB
- Apple T2 Security Chip:
 - Secure Enclave coprocessor
 - Secure boot
 - Encrypted storage
- Connections and Expansion:
 - Four Thunderbolt 3 (USB-C) ports
 - Two USB 3 ports
 - HDMI port
 - 3.5 mm headphone jack
- Communications:
 - 802.11ac Wi-Fi wireless networking
 - Bluetooth 5.0 wireless technology
 - 10/100/1000BASE-T Ethernet, configurable to Nbase-T Ethernet with support for 1Gb, 2.5Gb, 5Gb, and 10Gb Ethernet using RJ-45 connector

For full technical specifications, refer to Apple Support Tech Specs at support.apple.com/specs/#macmini.

Diagnostics:

- Apple Service Toolkit version 2 (AST 2)
- System Configuration must be performed after a logic board repair. Failure to perform this step will result in an inoperative system and an incomplete repair. For more information, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#).

Important Service Considerations:

- **Important:** Only Apple-certified technicians should repair this computer. For more information, refer to [OP1859: About Apple service certifications](#).
- **System Configuration:** Mac mini (2018) will not start up after a logic board replacement until System Configuration has been performed. For instructions on how to use System Configuration, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#).
- **Data Transfer:** Desktops and notebooks that have the Apple T2 Security Chip include security features that require a specific process for transferring data when the computer appears unresponsive. Data from a damaged logic board can sometimes be captured and transferred before service. For more information, refer to [TP1658: Data Transfer for Macs with the Apple T2 Security Chip](#).
- **Startup Security:** By default, security features keep the Mac mini (2018) from being able to NetBoot, without disabling security features. For instructions on how to boot to an external drive or another computer, refer to the following articles:
 - [HT202796: How to select a different startup disk](#)

- [HT208330: About Secure Boot](#)
- [HT208198: About Startup Security Utility](#)
- [HT201462: How to use target disk mode to move files to another computer](#)
- **Screw Torque Values:** The following screws require specific torque settings (refer to the individual procedure for the settings):
 - Antenna plate screws (923-00155 and 923-00157)
 - Logic board screws (923-02802)
- **Coin Cell Battery:** The coin battery is secured with a mylar adhesive cover. Reuse the cover when replacing the battery.
 - **Note:** Effective immediately, some coin cell batteries used on Mac systems are now available only from electronics parts distributors (for example, MCM). The coin battery noted below is no longer available to order via GSX. When the Mac repair process indicates the noted coin battery needs to be replaced, please order it from an electronics parts distributor. BR2032 and CR2032 batteries have the same form factor and nominal voltage. However, BR2032 batteries have a lower self-discharge rate and broader operating temperature range than CR2032 batteries for longer shelf and service life.

Special Tools:

- Adjustable torque driver 0.3–1.2 Nm (923-0735)

Mac mini (2018) Serial Number Location

Mac mini (2018) serial number is located on the bottom of the housing.



System Configuration for Macs with the Apple T2 Security Chip

For Macs with the Apple T2 Security Chip, the repair process is not complete for certain parts replacements until the AST 2 System Configuration suite has been run. Failure to perform this step will result in an inoperative system and an incomplete repair.

- For MacBook Pro (2018): Display assembly, logic board, top case, and Touch ID board
- For MacBook Air (Retina, 13-inch, 2018): Logic board and Touch ID board
- For iMac Pro: Logic board and flash storage
- For Mac mini (2018): Logic board

Important: Before starting this procedure, make sure the customer's current data is backed up.

Notes:

- If the serial numbers are not entered and saved in the repair system correctly, the necessary suites will not become available.
- The serial number must be entered in upper case characters. To ensure accuracy, it is recommended to scan the QR code on the logic board.

Tools:

- Power cord
- USB-C to USB-C Charge Cable included with portables (661-06670) or USB-A to USB-C Apple TV Restore Cable (923-00504)



- Customer's computer with a compatible keyboard and mouse or trackpad connected via USB (desktops only).
- A host computer with:
 - macOS Mojave 10.14 or later and the latest version of iTunes installed.
 - Mac Configuration Utility (MCU) installed. For information on how to set up the host computer, refer to [OP476: Latest Apple Service Toolkit download links and documentation](#).
 - Internet connection.

Steps:

1. Start an AST 2 diagnostic session from an iPad or other device.
2. Connect the customer's computer to the host computer. If the host computer does not have a USB-C port, use a USB-C to USB-A cable. It is important to connect the USB-C cable to the correct port or the process will not run.
 - For notebooks: Use only the USB-C port closest to the caps lock key.



- For iMac Pro: Use only the USB-C port closest to the Ethernet port.



- For Mac mini (2018): Use only the USB-C port closest to the HDMI port.



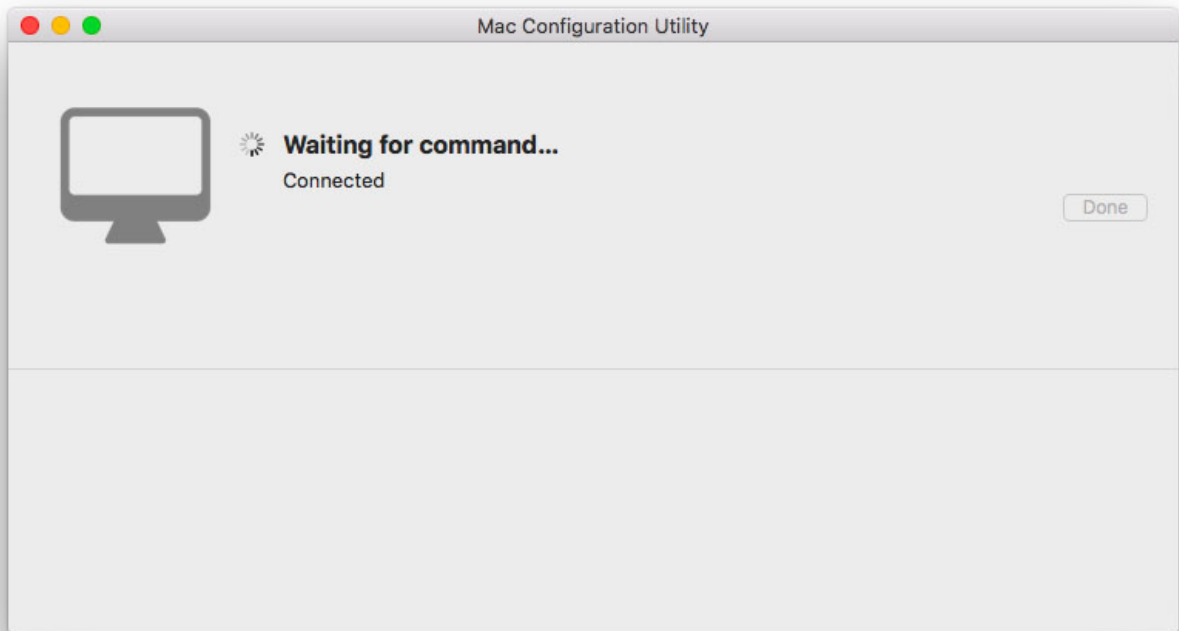
3. Verify that the host computer is turned on, connected to power, and connected to the Internet.

4. Start up the customer's computer in DFU mode.

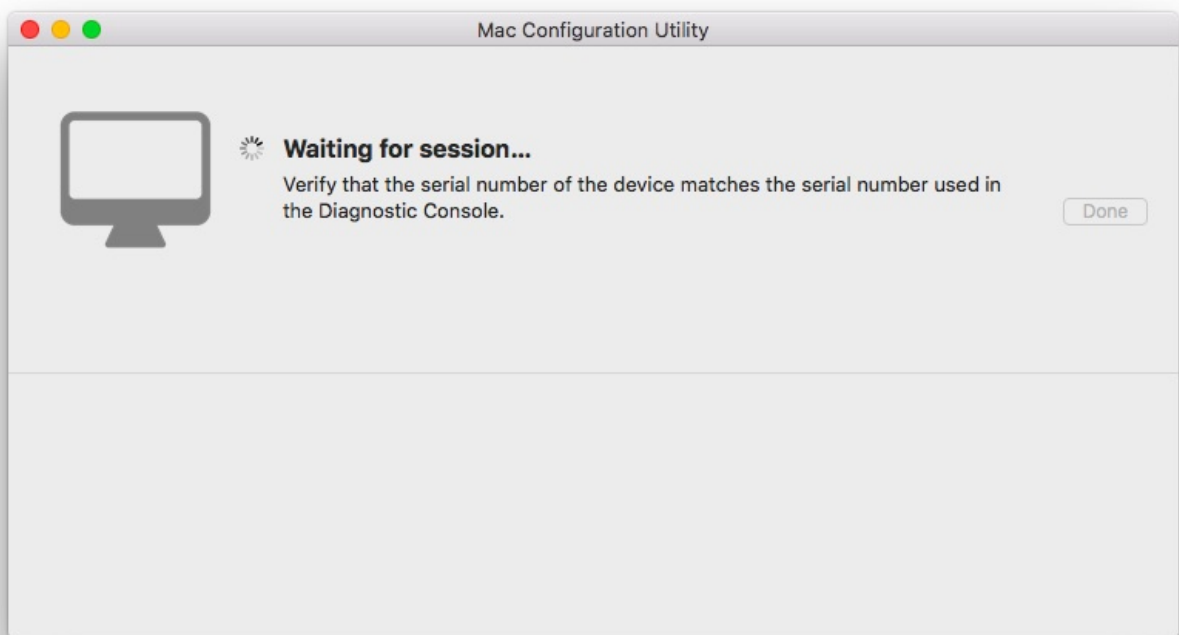
- For desktops: Press and hold the power button on the rear enclosure and connect the power cord. Continue to hold the power button until you see the device appear in Mac Configuration Utility, which may take up to 10 seconds.
- For notebooks: Press and hold the power button, then press and hold Left Control-Left Option-Right Shift until you see the device appear in Mac Configuration Utility, which may take up to 10 seconds.



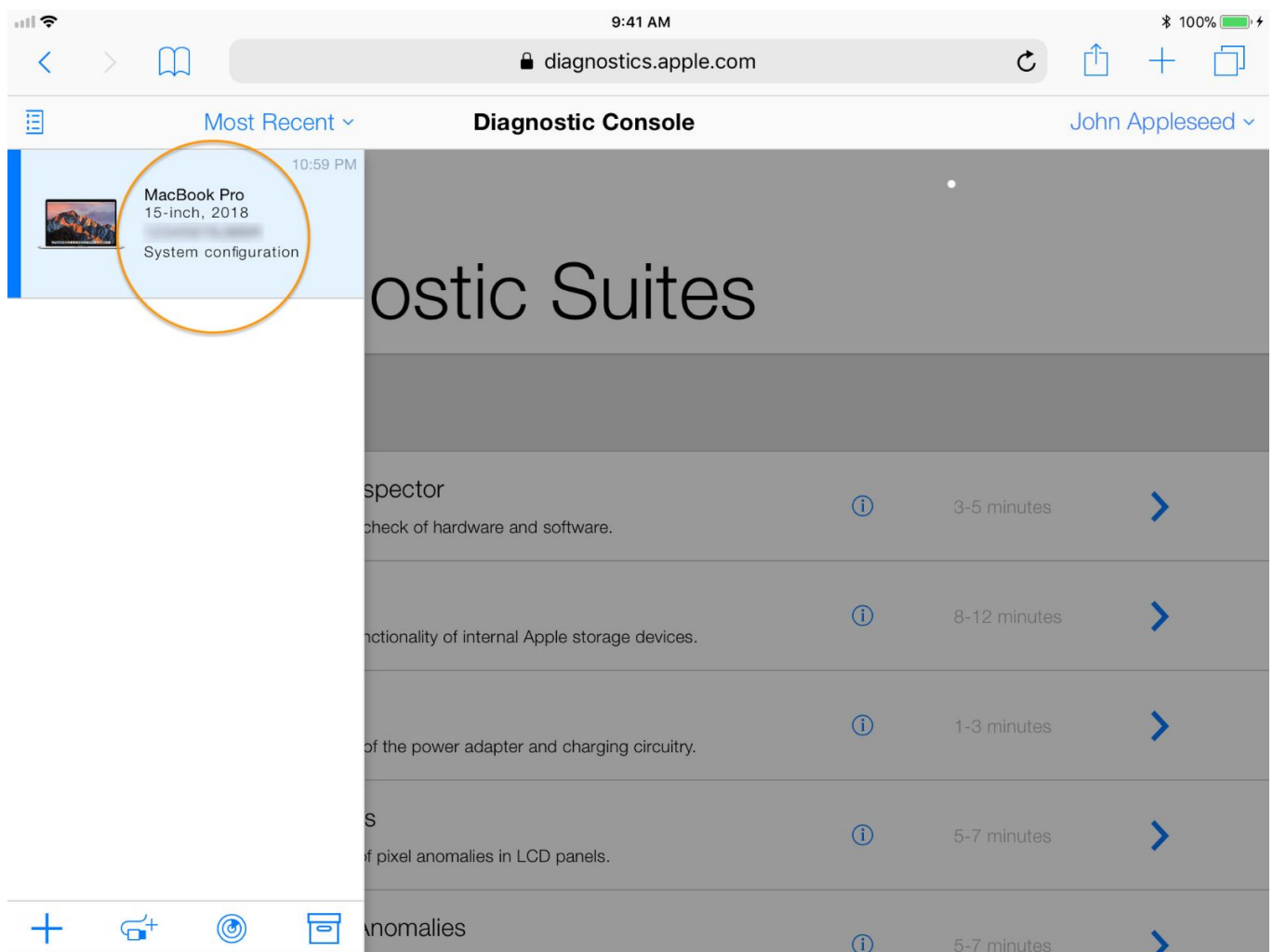
5. MCU will automatically launch and a dialog box will appear on the host computer screen.



Note: If a diagnostic session has not been created yet, this message will appear:



6. Confirm that the customer's computer appears online in the Diagnostic Console. **Note:** If the computer does not appear, the serial number may have been entered incorrectly or the repair was not saved correctly. Both the system serial number and the part serial numbers must be accurate to continue.



7. Choose the System Configuration suite from the Diagnostic Console. **Note:** While the process is running, the customer's display remains blank most of this time. Firmware restoration will take about five minutes.







9:41 AM 100%

diagnostics.apple.com







Diagnostic Console John Appleseed

Diagnostic Suites

POST-REPAIR

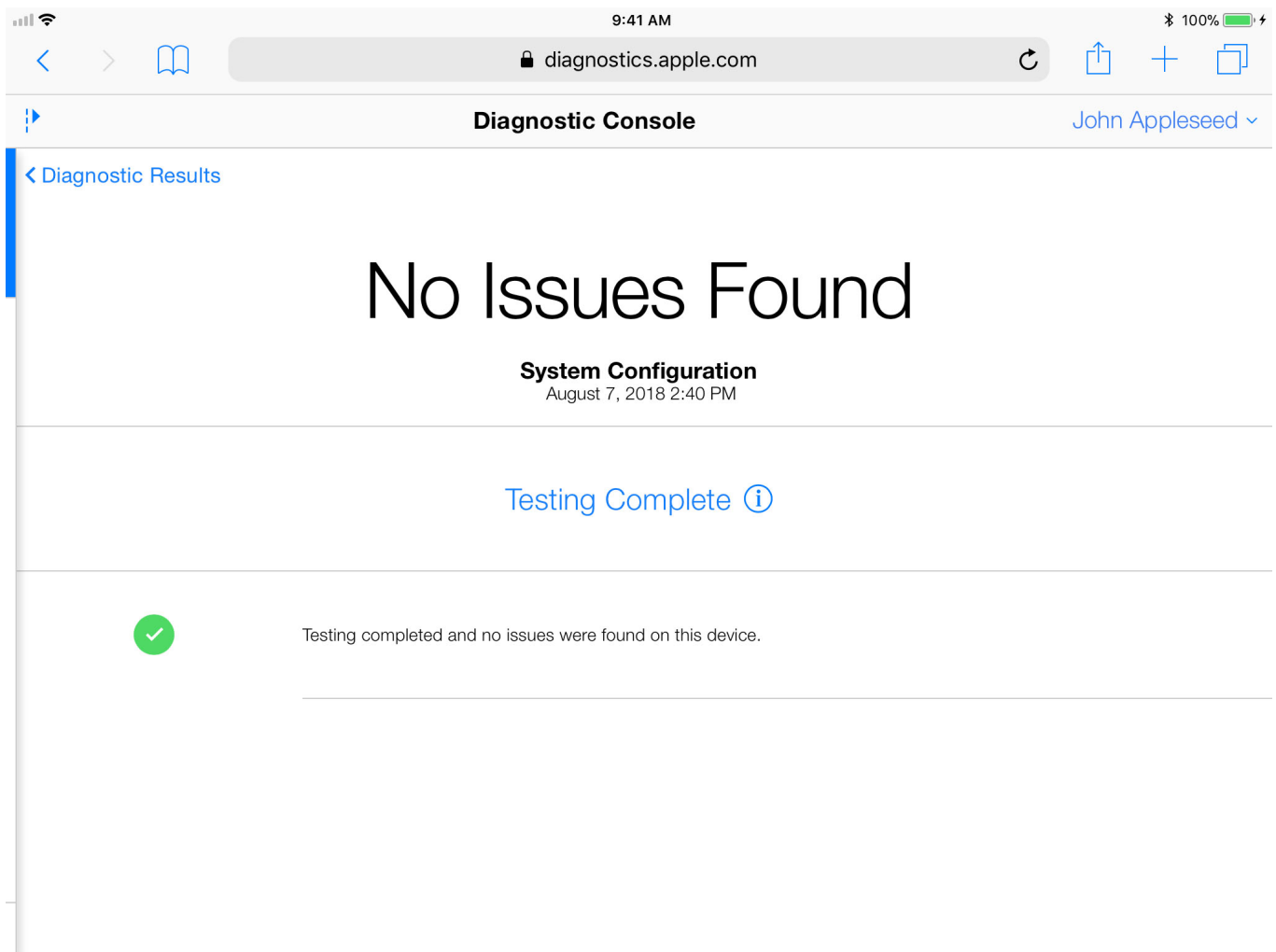
	Full System Diagnostic (EFI) Performs comprehensive testing of hardware functionality and memory module integrity.		30-90 minutes	
	Full System Diagnostic (OS) Performs comprehensive testing of hardware and graphics functionality.		15-30 minutes	

REPAIR COMPLETION

	System Configuration Completes required configuration of applicable service parts and updates firmware after repair. This suite becomes available after service part serial numbers are saved in a repair. For more information refer to TP1657: System Configuration.		1-10 minutes	
	Trackpad Calibration Check Verifies calibration of the trackpad actuator and force sensor. This suite must be run each time the computer is opened and reassembled.		3-7 minutes	

8. Toward the end of the process, the Apple logo and a progress bar will appear.

9. The customer's computer will restart and test results will appear in the Diagnostic Console of AST 2.



10. If no issues found, restart the customer's computer and run MRI and all applicable diagnostics to complete the repair.

Note: For notebooks, macOS does not need to be reinstalled. For desktops, macOS does need to be reinstalled. Shut down the desktop and then restart in recovery mode to install the macOS from Internet Recovery. Internet speeds may adversely impact the ability to restore from Internet Recovery.

11. If issues found:

- Confirm that all setup steps were followed correctly. For information on how to set up the host computer, refer to [OP476: Latest Apple Service Toolkit download links and documentation](#).
- Confirm that serial numbers for all parts, both new and old, were saved correctly into the repair system.
- Archive the AST 2 session, create a new one, and rerun the System Configuration suite.
- Quit and relaunch MCU. If unsuccessful, reboot the host computer.
- Rerun the suite.

Troubleshooting Tips:

If the System Configuration suite is unavailable, check the following:

1. Verify that the new and old service part serial numbers were entered correctly for all parts used and saved into the repair system.
2. Verify that the correct serial number of the customer's computer was entered into the Diagnostic Console.
3. Verify that the serial number of the customer's computer was used to create the repair.
4. Verify that the device is correctly connected to the host Mac and that Mac Configuration Utility is running.
5. A correctly connected device will show as "Apple Mobile Device (DFU Mode)" in System Information > USB.
6. Do not use USB-C to USB-A cable (923-00504) combined with USB-C to USB Adapter (MJ1M2AM/A).

If the device goes offline while running System Configuration or the suite does not complete, check the following:

1. Archive the AST 2 session, create a new one, and rerun the System Configuration suite.
2. Restart the host Mac.
3. Open the device and confirm that all internal components were properly installed.
4. Check for system outages.

Diagnostic Software

Apple Service Toolkit 2 (AST 2) Overview

- AST 2 is a cloud-based diagnostic system to help technicians triage and verify repairs for Mac computers.
- AST 2 is accessed via GSX.
- AST 2 includes many of the same diagnostic suite tests that are available in AST.
- With AST 2, technicians can initiate diagnostics wirelessly on a customer's device and view diagnostic results using a Diagnostic Console (a web application on a Mac or iPad).
- To access the Diagnostic Console, log into GSX and click the Request Diagnostics button at the top of the screen.
- AST 2 diagnostic suites are delivered from the cloud to the device using the Diagnostic Console.
- In the original Apple Service Toolkit (AST), the diagnostics are delivered to the device (using the device itself) from the local Diagnostic Gateway server.
- In AST 2, the unit under test (UUT) communicates directly with the Diagnostic Console over the cloud. Every time you run a diagnostic, the latest version of the diagnostic tool is used.

For more information, refer to the following articles:

- [TP1103: AST 2 Reference Guide – Overview](#)
- [TP1105: AST 2 for Mac Reference Guide - Table of Contents](#)
- [TP1118: AST 2 for Mac Reference Guide - Table of Contents \(Retail\)](#)
- [OP476: Latest Apple Service Toolkit download links and documentation](#)
- [HT202731: How to use Apple Diagnostics on your Mac](#)



For Mac mini (2018): System Configuration

- [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#)
Important: Mac mini (2018) may not start up after a logic board replacement until System Configuration has been performed. Failure to perform this step will result in an inoperative system and an incomplete repair.

General Troubleshooting

Update Software and Firmware

Important: Before troubleshooting, ensure the correct version of macOS is installed, and check for and apply the latest software and firmware updates. Computers sometimes exhibit symptoms that indicate the incorrect version of macOS is installed. Refer to [HT201686: Use the Mac operating system that came with your Mac, or a compatible newer version](#) to make sure system build is correct for this computer model.

Firmware refers to software that is written into memory circuits such as flash memory, which will hold the software code indefinitely, even when power is removed from the hardware. Firmware on Intel-based Mac computers prior to computers with an Apple T2 Security Chip is designed to be updated if necessary by running macOS Software Update (available in the Apple () menu under About This Mac) while the computer is connected to the Internet.

For computers with an Apple T2 Security Chip, SMC and EFI separate firmware images have now both been integrated into bridgeOS.

Troubleshooting Techniques

For more information, go to [ATLAS](#) and enter “troubleshooting” in the search field.

Hardware versus Software

To isolate a hardware issue from a software issue, refer to [HT203161: Isolating issues in macOS](#).

To troubleshoot a software issue, refer to the following articles:

- [HT201516: How to troubleshoot a software issue](#)
- [HT201861: About incompatible software on your Mac](#)
- [HT204323: If a flashing question mark appears when you start your Mac](#)
- [HT204904: How to reinstall macOS from macOS Recovery](#)
- [HT202574: About Fusion Drive, a storage option for some Mac computers](#)

Quick Check Procedures

System Configuration for Macs with the Apple T2 Security Chip

Important: For Macs with the Apple T2 Security Chip, the repair process is not complete for certain parts replacements until the AST 2 System Configuration suite has been run. Failure to perform this step will result in an inoperative system and an incomplete repair.

- [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#)
 - For MacBook Pro (2018): Display assembly, logic board, top case, and Touch ID board
 - For MacBook Air (Retina, 13-inch, 2018): Logic board and Touch ID board
 - For iMac Pro: Logic board and flash storage
 - For Mac mini (2018): Logic board

Resetting the System Management Controller (SMC)

The System Management Controller (SMC) is a chip on the logic board that controls all power functions. On some Mac computers, the Apple T2 Security Chip integrates several controllers—such as the SMC, image signal processor, audio controller, and SSD controller. If the computer is experiencing any power issue, such as not starting up, not displaying video, sleep issues, or fan noise issues, resetting the SMC may resolve it.

For more information and instructions to reset the SMC on different computer models, refer to [HT201295: How to reset the System Management Controller \(SMC\) on your Mac](#).

Note for iMac: If the power button is pressed while the power cord is being inserted, the iMac will enter a mode that runs the fans at full speed. For more information, refer to [HT204463: iMac: Fans run at full speed after computer turns on](#).

Note for iMac Pro (2017): If the power button is pressed while the power cord is being inserted, the iMac will enter Device Firmware Upgrade (DFU) mode and will need to be restored.

Resetting Nonvolatile RAM (NVRAM)

NVRAM stores certain system and device settings in a location that macOS can access quickly. Exactly which settings are stored in the computer's NVRAM varies depending on the type of computer, connected devices, and drives. To reset NVRAM:

For information, refer to [HT204063: How to Reset NVRAM or PRAM on your Mac](#).

Starting Up in Safe Mode

Safe mode (sometimes called safe boot) is a way to start up a Mac so that it performs certain checks and prevents some software from automatically loading or opening. These changes can help resolve or isolate certain issues on the startup disk.

For information, refer to [HT201262: Use safe mode to isolate issues with your Mac](#).

Mac mini (2018) Thermal and Electrical Sensors

Mac mini (2018) Thermal and Electrical Sensors

Reference the tables below for sensor information.

- Thermal Sensor Table
- Electrical Sensor Table

Thermal Sensor Table

SMC Name	Location	General Description (Degrees C)	Diagnosis
TALC	Logic board bottom side, front, near coin battery	Airflow ambient intake temperature	Excessive temperature on the logic board. Check fan operation.
TARC	Logic board bottom side, rear, near ports	Airflow exhaust temperature	Excessive temperature on the logic board. Check fan operation.
TC0P	Logic board bottom side, near CPU	CPU proximity temperature	Excessive CPU temperature or logic board sensor near CPU is damaged or disconnected from SMC.
TC1C	Logic board bottom side, inside CPU	CPU IC - Digital Core 0 temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TC2C	Logic board bottom side, inside CPU	CPU IC - Digital Core 1 temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TC3C	Logic board bottom side, inside CPU	CPU IC - Digital Core 2 temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TC4C	Logic board bottom side, inside CPU	CPU IC - Digital Core 3 temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TC5C	Logic board bottom side, inside CPU	CPU IC - Digital Core 4 temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TC6C	Logic board bottom side, inside CPU	CPU IC - Digital Core 5 temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TCAP	Logic board top side, right	T2 proximity temperature	Excessive T2 temperature or logic board sensor near T2 IC is damaged or disconnected from SMC.
TCGC	Logic board bottom side, inside CPU	CPU GT core temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TCSA	Logic board bottom side, inside CPU	CPU system agent core temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TCXC	Logic board bottom side, inside CPU	CPU core PECL temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TH0A	Logic board bottom side, front, near flash storage	Flash storage NAND proximity temperature	Excessive flash storage temperature or logic board sensor near flash storage is damaged or disconnected from SMC.
TH0B	Logic board bottom side, front, near flash storage	Flash storage NAND proximity temperature	Excessive flash storage temperature or logic board sensor near flash storage is damaged or disconnected from SMC.
TIED	Logic board top side, right, inside Ethernet IC	10Gb Ethernet IC temperature	Excessive Ethernet IC temperature or internal IC sensor is damaged or disconnected from SMC.











TM0P	Logic board bottom side, between SO-DIMM memory slots	Memory proximity temperature	Excessive memory area temperature or logic board sensor near memory is damaged or disconnected from SMC.
TPCD	Logic board bottom side, inside PCH IC	PCH IC temperature	Excessive PCH temperature or internal PCH sensor is damaged or disconnected from SMC.
TPSD	Inside power supply	Power supply temperature	Excessive power supply temperature or sensor is damaged or disconnected from SMC. Check power supply connections and fan operation.
TTTD	Logic board top side, rear, near USB-C ports	Thunderbolt IC temperature	Excessive I/O temperature or internal IC sensor is damaged or disconnected from SMC. Check USB-C I/O connections and fan operation.
TTXD	Logic board top side, rear, near USB-C ports	Thunderbolt IC temperature	Excessive I/O temperature or internal IC sensor is damaged or disconnected from SMC. Check USB-C I/O connections and fan operation.
TW0P	Logic board top side, left, near wireless IC	Wireless proximity temperature	Excessive temperature on the logic board near the wireless IC.
TW1P	Logic board top side, left, near wireless IC	Wireless proximity temperature	Excessive temperature on the logic board near the wireless IC.
TW2P	Logic board top side, left, near wireless IC	Wireless proximity temperature	Excessive temperature on the logic board near the wireless IC.

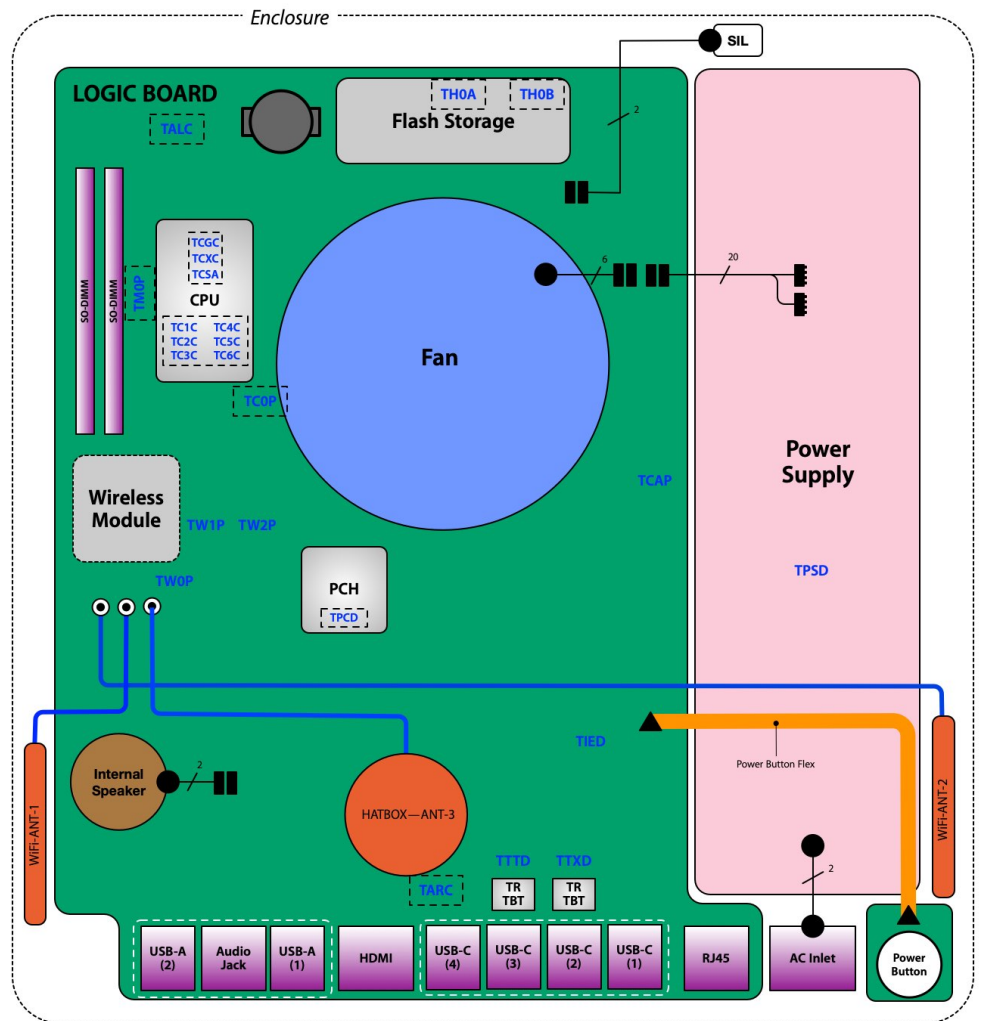
Electrical Sensor Table

SMC Name	Location	General Description	Units	Diagnosis
IAPC	Logic board	Current: WLAN	Amperes	Out-of-range Wi-Fi current found or open signal to SMC.
IC0R	Logic board	Current: CPU (high)	Amperes	Out-of-range CPU current was found or open signal to SMC.
ICAC	Logic board	Current: CPU core (low)	Amperes	Out-of-range CPU current was found or open signal to SMC.
ICIC	Logic board	Current: CPU VCCIO (low)	Amperes	Out-of-range CPU current was found or open signal to SMC.
ICSC	Logic board	Current: CPU VCCSA (low)	Amperes	Out-of-range CPU current was found or open signal to SMC.
ICTC	Logic board	Current: CPU GT (low)	Amperes	Out-of-range CPU current was found or open signal to SMC.
ID0M	Logic board	Current: 12VDC input	Amperes	Out-of-range DC-IN current. Possible defective power supply or open signal to SMC. Verify power supply connections.
IE2R	Logic board	Current: 10GbE 12V (high)	Amperes	Out-of-range Ethernet current was found or open signal to SMC.
IE3R	Logic board	Current: 10GbE 3.3V (high)	Amperes	Out-of-range Ethernet current was found or open signal to SMC.
IH0C	Logic board	Current: SSD 3.3V (high)	Amperes	Out-of-range flash storage current found or open signal to SMC.
IH0R	Logic board	Current: SSD 12V (high)	Amperes	Out-of-range flash storage current found or open signal to SMC.
IM0C	Logic board	Current: DDR memory VPP (low)	Amperes	Out-of-range memory current found or open signal to SMC.
IM0R	Logic board	Current: DDR memory VDDQ (low)	Amperes	Out-of-range memory current found or open signal to SMC.
IO3R	Logic board	Current: Other 3.3V (high)	Amperes	Out-of-range current from the CPU's integrated voltage regulators.
IO5R	Logic board	Current: Other 5V (high)	Amperes	Out-of-range current from the CPU's integrated voltage regulators.
ISLC	Logic board	Current: Calpe 3.3V Vdd (low)	Amperes	Out-of-range logic board current found or open signal to SMC.
IU3C	Logic board	Current: Thunderbolt 3.3V main	Amperes	Out-of-range Thunderbolt current found or open signal to SMC.
IU5C	Logic board	Current: USB-C 5V	Amperes	Out-of-range USB-C current found or open signal to SMC.
IUAC	Logic board	Current: USB-A 5V	Amperes	Out-of-range USB-A current found or open signal to SMC.
VCAC	Logic board	Voltage: CPU core	Volts	Out-of-range voltage from the CPU's integrated voltage regulators.
VCSC	Logic board	Voltage: CPU VCCSA	Volts	Out-of-range voltage from the CPU's integrated voltage regulators.
VCTC	Logic board	Voltage: CPU GT	Volts	Out-of-range voltage from the CPU's integrated voltage regulators.
VD0R	Logic board	Voltage: 12VDC input	Volts	Out-of-range DC-IN voltage. Possible defective power supply or open signal to SMC. Verify power supply connections.

Mac mini (2018) Interconnect Diagram

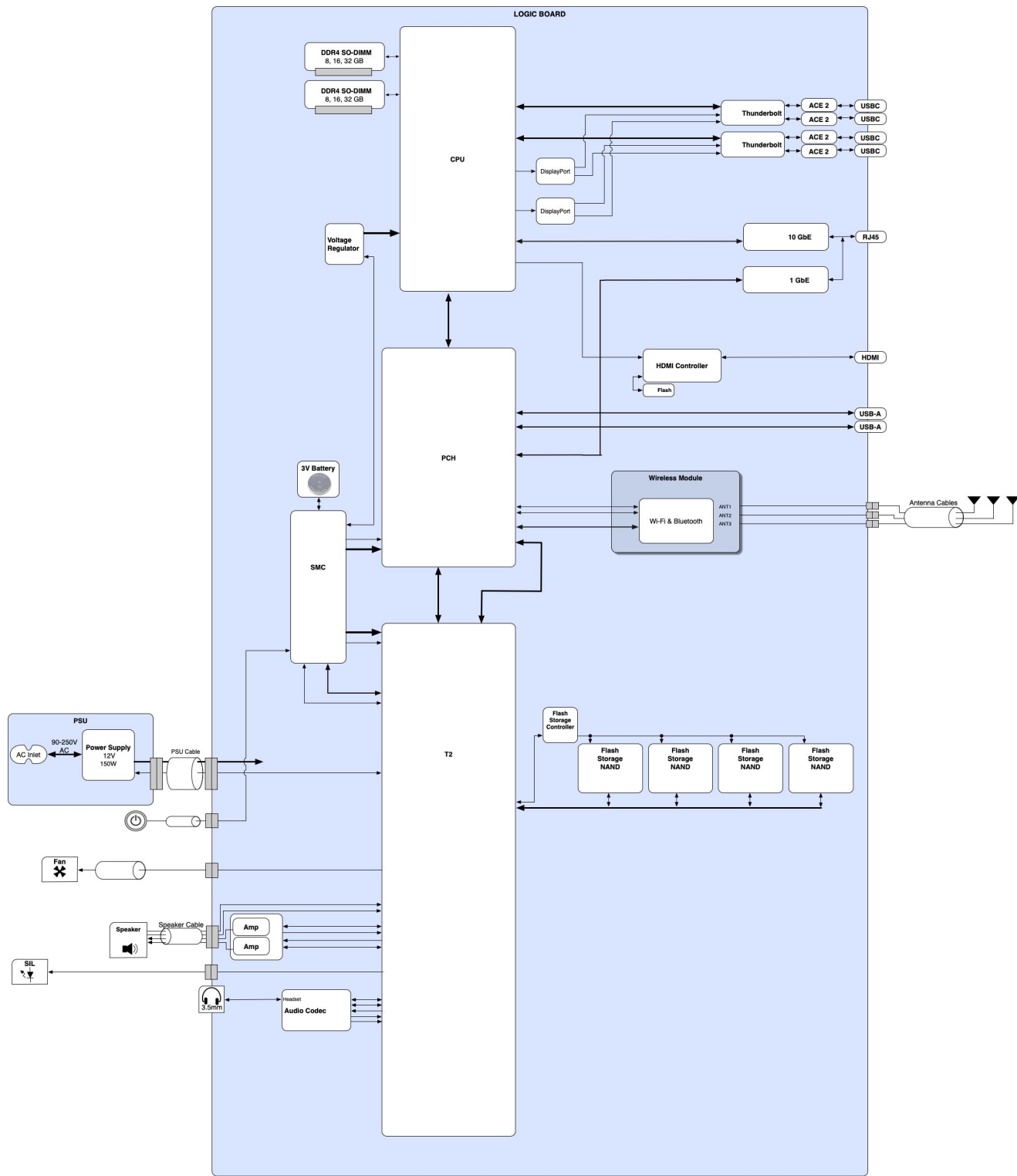
Mac mini (2018) Interconnect Diagram

LEGEND	
	Flex
	Coax
	Wire
	ZIF
	WTB
	Direct Solder
	Custom Conn
	# of Lanes/Wires
	Temperature sensor (top-side)
	Temperature sensor (bottom-side)



Mac mini (2018) Block Diagram

Mac mini (2018) Block Diagram



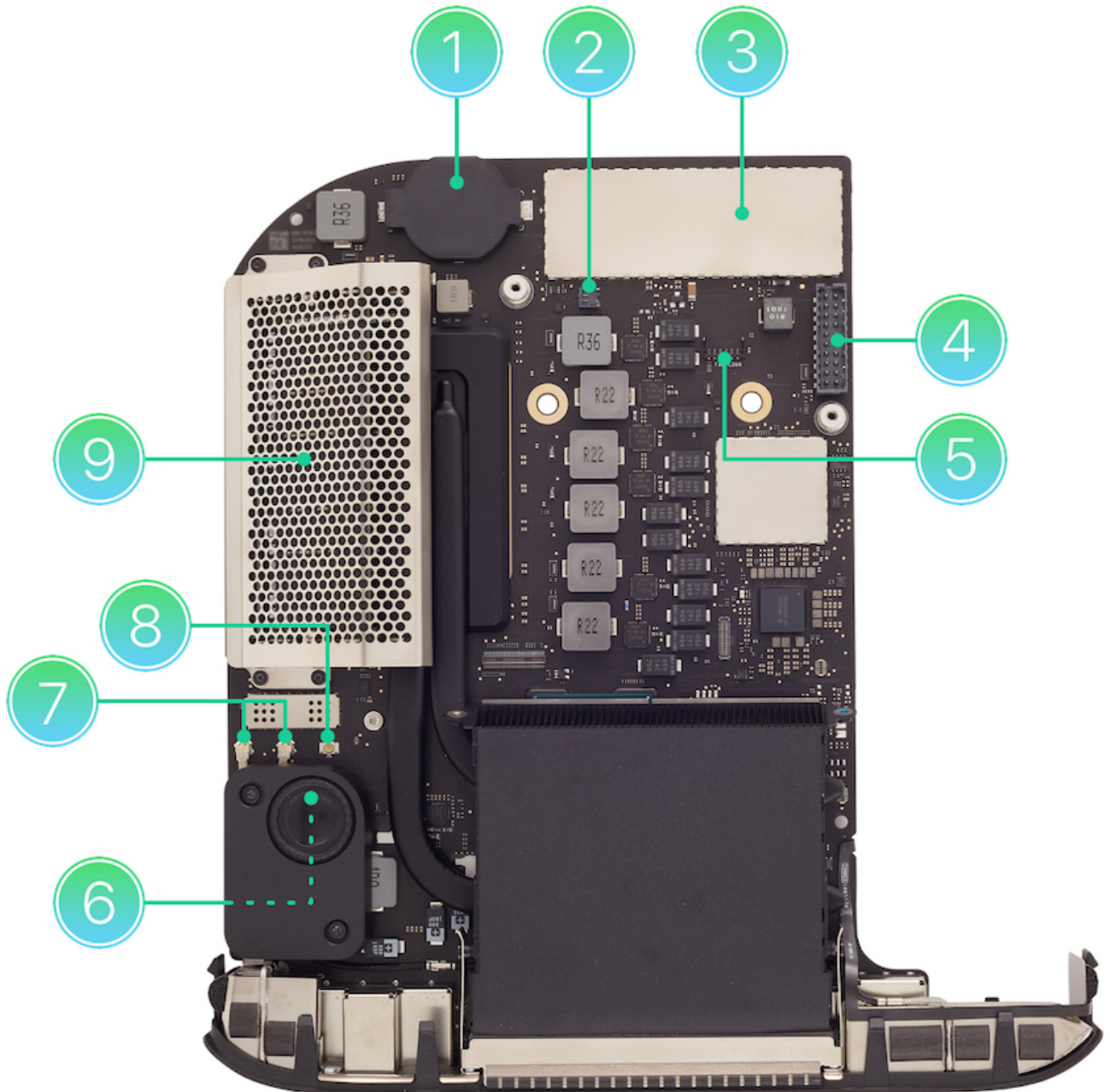
Mac mini (2018) Functional Overview

Mac mini (2018) Functional Overview

For information on sensors and cable connections, refer to [TP1712: Interconnect Diagram](#).

Bottom of Logic Board

Refer to this diagram for symptoms related to the connectors on the bottom of the logic board.



1 = Backup battery (coin cell battery)

- Incorrect date and time settings
- Incorrect configuration settings
- No startup or video

2 = Status Indicator Light (SIL) connector

- No power ON (shorted cable)
- No sleep LED status

3 = Flash storage (soldered on logic board)

- No flash storage listed in System Information
- Will not start up from flash storage

4 = Power supply connector

- Computer does not turn on
- Intermittent shutdowns
- Fan runs unusually fast (power supply thermal sensor not reading)

5 = Fan connector

- Not running or running fast
- System freezes
- Intermittent shutdowns

6 = Internal speaker connector

- No internal speaker sound
- Distorted sound from internal speaker

7 = Wireless antenna connectors (2) (I/O Wall)

8 = Wireless antenna connector (1) (Antenna Plate)

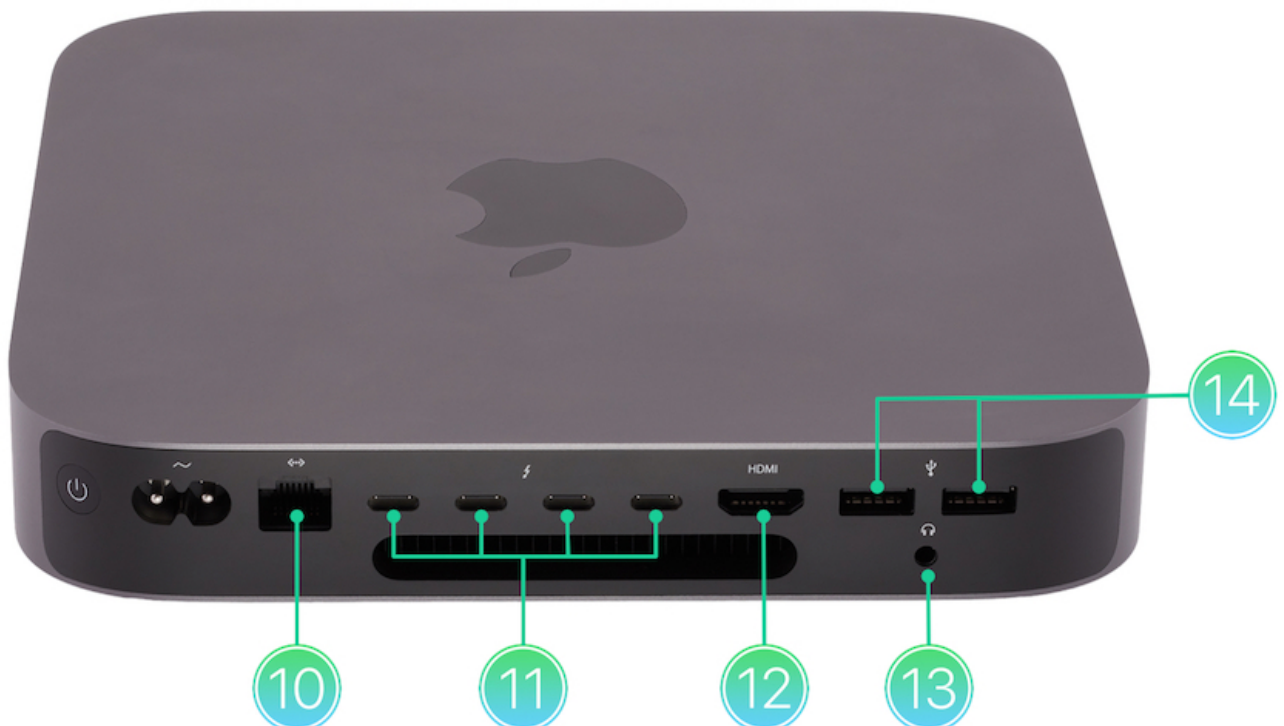
- Weak signal strength over Wi-Fi or Bluetooth
- Cannot connect to Wi-Fi networks or Bluetooth peripherals
- Slow Wi-Fi or Bluetooth connection speed

9 = SO-DIMM memory connectors (2)

- Error beep tones on startup
- Freeze or kernel panic
- Computer does not completely start up

External connectors on the logic board

Refer to this diagram for symptoms related to external connectors on the logic board.



10 = Ethernet RJ-45 port

- No wired Ethernet connectivity
- Wired Ethernet data transfer issues

11 = Thunderbolt 3 (USB-C) ports (4)

- USB connectivity issues
- USB power issues
- No video to external display
- No audio to external display speakers
- Thunderbolt device not found
- Thunderbolt controller not recognized
- Thunderbolt driver issue
- Thunderbolt power issues

12 = HDMI port

- No HDMI video connectivity to external display
- Distorted image on external display

13 = Audio jack (input/output) (3.5 mm)

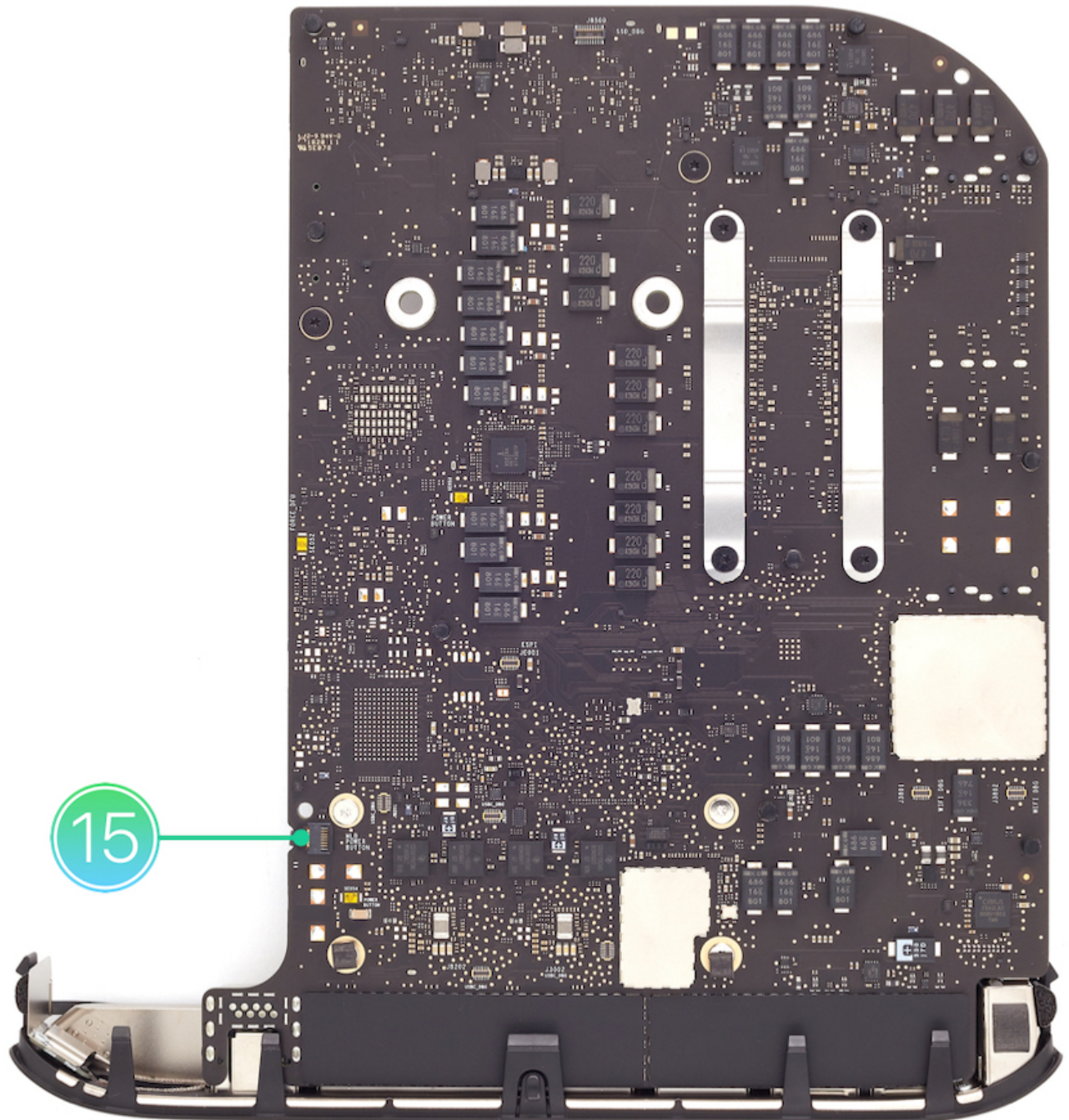
- No external analog audio input
- No external analog audio output
- No headset controls or mic input

14 = USB 3 ports (2)

- USB connectivity issues
- USB power issues

Top of Logic Board

Refer to this diagram for symptoms related to the connector on the top of the logic board.



15 = Power button flex cable connector

- Computer does not turn on when power button is pressed

Recovering a Lost Firmware Password

Only technicians at Apple Stores or Apple Authorized Service Providers can unlock the following Mac models when they are protected by a firmware password:

- iMac (Mid 2011) and later
- iMac Pro (2017)
- MacBook (Retina, 12-inch, Early 2015) and later
- MacBook Air (Late 2010) and later
- MacBook Pro (Early 2011) and later
- Mac mini (Mid 2011) and later
- Mac Pro (Late 2013)

Refer to the technician instructions in [HT204455: How to set a firmware password on your Mac](#).

PRAM Reset and Measuring Coin Cell Battery Voltage

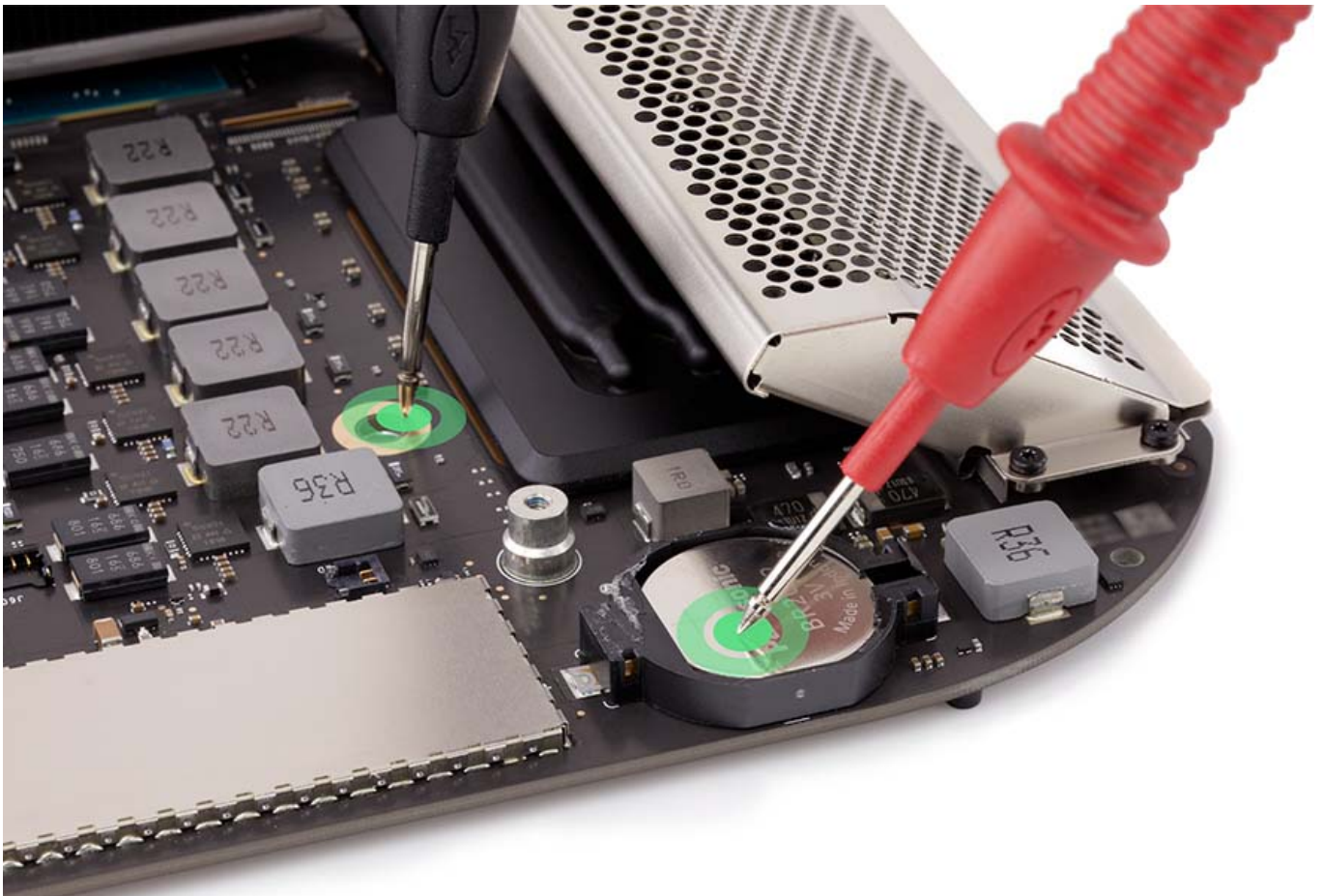
Reset NVRAM or PRAM

A dead coin cell battery may prevent the computer from operating. Removing the battery for 1–2 minutes will fully reset the NVRAM (nonvolatile random-access memory) or PRAM (Parameter RAM). The steps for resetting NVRAM and PRAM are the same. This article will refer to NVRAM. Refer to the Service Guide for removal and reassembly steps of the coin cell battery. For additional information on NVRAM and PRAM, refer to [HT204063: Reset NVRAM or PRAM on your Mac](#).

Measuring the Coin Cell Battery Voltage

1. Shut down the computer.
2. Disconnect all cables and unplug the power cord.
3. Follow the steps listed in the Service Guide to remove the logic board.
Note: The coin cell battery provides power to the RTC (real-time clock) and NVRAM when the computer is not connected to AC power.
4. Measure the battery voltage by using a voltmeter set for DC. Refer to [HT3250: Using a digital multimeter](#).
5. The battery can be measured two ways. If you measure the battery while it is installed in the logic board, touch the positive multimeter probe (red) to the positive side of the battery and the negative multimeter probe (black) to a metal grounding point on the logic board chassis. If you measure the battery after removing it from the logic board, touch the positive multimeter probe to the positive side of the battery and the negative multimeter probe to the negative side of the battery. If the voltage is 2.7V or less, replace the battery.
6. Reinstall the coin cell battery and reassemble the computer.
7. Turn on the computer.
8. If the computer starts up successfully, check for and apply the latest software and firmware updates.
9. The removal of the coin cell battery also resets the date and time. Use System Preferences > Date & Time to adjust back to the actual date and time settings.

Mac mini (2018) pictured below:



Bluetooth Issues

Unlikely causes:

Bottom cover, fan, housing, memory, power supply, sleep indicator light, speaker.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Bluetooth service not available• Cannot turn Bluetooth on• Bluetooth can be turned on, but the computer is unable to pair with a known-good Bluetooth device• Intermittent loss of communication with paired Bluetooth device• Data transfer over Bluetooth times out or is too slow <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<ol style="list-style-type: none">1. In System Preferences > Bluetooth, check that Bluetooth is on.2. Attempt to pair the computer with a known-good Bluetooth keyboard, mouse, or trackpad.3. Reset the Bluetooth device or delete the pairing (if applicable).4. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model.5. Check for and apply the latest software and firmware updates.6. If the customer is using a USB 3 device, review HT201163: Using USB devices with your Mac to identify possible interference with Wi-Fi and Bluetooth communications if the device is positioned near their antennas.7. If the user's computer pairs Bluetooth normally at your service location, research potential sources of interference in the user's environment, such as microwave ovens or cordless phones in the 2.4/5GHz range. Refer to HT201542: Potential sources of Wi-Fi and Bluetooth interference.8. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.9. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Check Mac Resource Inspector diagnostic suite (MRI) test results or System Information > Hardware > USB device tree to verify that the Bluetooth controller is listed.</p> <p>Is Bluetooth hardware detected?</p>	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M36	MLB
2.	<p>Open System Preferences > Bluetooth. Remove all paired devices. Pair the computer with a known-good Bluetooth device.</p> <p>Does the computer pair with a known-good Bluetooth device?</p>	Yes	Go to the “External Apple Bluetooth Peripherals” troubleshooting flow.	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	<p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user’s computer.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Try to connect to the known-good Bluetooth device. Compare Bluetooth performance and reliability to a known-good computer of similar type and Bluetooth specification.</p> <p>Does the issue persist with known-good macOS?</p>	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	<p>Reinstall macOS on the user’s computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.noSymptomCode)	
4.	<p>Locate the wireless antenna connectors on the logic board. Unplug them and inspect the antenna cables and their connectors for any signs of pinched wires or connector damage.</p> <p>Do the antenna cables or connectors show signs of damage?</p>	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Go to step 6.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
5.	Determine which wireless antenna is damaged: A. Antenna going to antenna plate B. Antennas going to rear I/O wall Which wireless antenna is damaged?	A	Replace the antenna plate. Verify that the issue is resolved.	X03	PIECE PART
		B	Replace the rear I/O wall. Verify that the issue is resolved.	X03	OTHER ELECTRIC
6.	With the antenna cables unplugged, inspect the wireless antenna cable connectors on the logic board for housing or pin damage. Do the antenna connectors on the logic board show signs of damage?	Yes	Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M24	MLB
		No	Go to step 7.	\$(nodeText.noSymptomCode)	
7.	Reseat the antenna cable connectors to the logic board, then retry pairing with a known-good Bluetooth device. Is the computer able to pair with a known-good Bluetooth device?	Yes	The issue was resolved by reseating the Bluetooth antenna to the logic board. Verify that the issue is resolved.	\$(nodeText.yesSymptomCode)	
		No	Go to step 8.	\$(nodeText.noSymptomCode)	
8.	Troubleshooting this issue completely requires the following known-good parts: <ul style="list-style-type: none"> • Antenna plate • Rear I/O wall Do you have immediate access to each of these known-good parts?	Yes	Go to step 9.	\$(nodeText.yesSymptomCode)	
		No	Replace the antenna plate. Verify that the issue is resolved.	X03	OTHER ELECTRIC
9.	Substitute known-good antenna plate, then retry pairing with a known-good Bluetooth device. Is the computer able to pair with a known-good Bluetooth device?	Yes	Replace the antenna plate. Verify that the issue is resolved.	X03	OTHER ELECTRIC
		No	Go to step 10.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
10.	Substitute known-good rear I/O wall, then retry pairing with a known-good Bluetooth device. Is the computer able to pair with a known-good Bluetooth device?	Yes	Replace the rear I/O wall. Verify that the issue is resolved.	X03	OTHER ELECTRIC
		No	Reinstall the user's rear I/O wall. Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M36	MLB
11.	Pair with a known-good Bluetooth device and verify that the connection is sustained for several minutes. Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Is the issue resolved?	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

Ethernet Issues

Unlikely causes:

Antenna plate, bottom cover, fan, housing, logic board, memory, power supply, rear I/O wall, sleep indicator light, speaker.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">No Ethernet device present.Unable to access Ethernet network resources.Ethernet device shows no connection.Ethernet device unable to get an IP address.Slow Ethernet network performance. <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">Verify that nothing is inserted into the Ethernet port on the user's computer. Visually inspect the port for damage or debris. Use compressed air to clean and remove any debris.Connect the user's computer to a known-good Ethernet network with a known-good Ethernet cable. Make sure the Ethernet cable's RJ-45 connector is not damaged and is securely connected to the Ethernet port on the computer. Remove the cable, then reconnect it to make sure it's connected properly and completely.Check System Preferences > Network to verify that built-in Ethernet is active and connected.Create a new network location in System Preferences.Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. Using Wi-Fi network interface, connect to the Internet, then check for and apply latest software and firmware updates.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Inspect the Ethernet port for dust, debris, damage, or bent pins. Use compressed air to remove debris. Plug in a known-good Ethernet cable and make sure all pins make physical contact with the connector.	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
	Is the Ethernet port damaged?				

	Check	Result	Action	Code	Commodity
2.	<p>Inspect the opening on the rear I/O wall for the damaged Ethernet port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the RJ-45 plug.</p> <p>Is the opening for the Ethernet port damaged or deformed?</p>	Yes	<p>Replace the rear I/O wall.</p> <p>Verify that the issue is resolved.</p>	X13	OTHER ELECTRIC
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
3.	<p>In System Preferences > Network > Ethernet, verify link status is Connected (green dot) and a valid IP address is listed. Connect the computer to an Ethernet network with a known-good DHCP server. Make sure static DHCP maps or filtering are not preventing address allocation.</p> <p>Note: DHCP allocation may not be instantaneous, depending on the network. Retest.</p> <p>Is Ethernet link status active?</p>	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M10	MLB

	Check	Result	Action	Code	Commodity
4.	<p>Use a simple hub/switch environment. Go to System Preferences > Network > Ethernet and obtain the Router IP address. Use Network Utility to ping the Router IP address.</p> <p>Is Network Utility able to ping Router IP address?</p>	Yes	No Ethernet connectivity issues detected. No repair necessary. Problem may be network environment. Refer user to TS1317: Troubleshooting a cable modem, DSL, or LAN Internet connection .	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M10	MLB
5.	<ol style="list-style-type: none"> 1. Connect Ethernet cable to known-good network with DHCP server. 2. In System Preferences > Network > Ethernet, verify link status is Connected (green dot). 3. Configure TCP/IP settings to Using DHCP and verify valid IP address is obtained from server (not a self-assigned one with 169.x.x.x). 4. Launch web browser. Verify you can access websites and download files. <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Wi-Fi Issues

Unlikely causes:

Bottom cover, fan, housing, memory, power supply, sleep indicator light, speaker.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Wi-Fi service not available• Cannot turn Wi-Fi on• Wi-Fi can be turned on, but cannot connect to known-good Wi-Fi network• Intermittent loss of Wi-Fi communication• Poor Wi-Fi signal <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. In System Preferences > Network, check that Wi-Fi is on.2. Attempt to connect the computer to a known-good Wi-Fi network.3. Create a new network location in System Preferences.4. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. Using Ethernet network interface, connect to the Internet, then check for and apply latest software and firmware updates.5. If the customer is using a USB 3 device, review HT201163: Using USB devices with your Mac to identify possible interference with Wi-Fi and Bluetooth communications if the device is positioned near their antennas.6. If the user's computer connects normally to Wi-Fi at your service location, research potential sources of interference in the user's environment, such as microwave ovens or cordless phones in the 2.4/5GHz range. Refer to HT201542: Potential sources of Wi-Fi and Bluetooth interference.7. Refer to HT202663: Check for Wi-Fi issues using your Mac to familiarize yourself with the macOS Wireless Diagnostic utility.8. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.9. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Check Mac Resource Inspector (MRI) test results or System Information > Network > Wi-Fi to verify that the wireless module is listed.</p> <p>Is Wi-Fi hardware detected?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M35	MLB
2.	<p>Run Wireless Diagnostics by holding down the Option key, clicking the wireless icon in the menu bar, and then choosing Open Wireless Diagnostics.</p> <p>Wireless Diagnostics can also be found at: /System/Library/CoreServices/Applications/WirelessDiagnostics.app</p> <p>Does the computer complete Wireless Diagnostics with no issues?</p>	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
3.	<p>Connect to a known-good wireless network and open Wireless Diagnostics > Window > Performance. Review the quality graph to evaluate the signal quality of the wireless connection. Verify that the signal is good or excellent, and that the transmission rate (Tx Rate) is comparable to another known-good computer of similar type and Wi-Fi specification. Where available, switch between 2.4GHz and 5GHz networks to verify that the signal quality is comparable to a known-good computer.</p> <p>Using a network with a high transmission rate, download a large file from a known-good website or file server. Compare network performance to another known-good computer of similar type and Wi-Fi specification. Verify throughput using Activity Monitor > Network.</p> <p>Are the performance and throughput comparable between the user's computer and a known-good computer?</p>	Yes	Wi-Fi performance is within specification. Verify that the issue is resolved.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
4.	<p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.</p> <p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume.</p> <p>Attempt to reproduce the Wi-Fi performance or connection issue.</p> <p>Does the issue persist with known-good macOS?</p>	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
		No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.noSymptomCode}`	
5.	<p>Locate the wireless antenna connectors on the logic board. Unplug them and inspect the antenna cables and their connectors for any signs of pinched wires or connector damage.</p> <p>Do the antenna cables or connectors show signs of damage?</p>	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 7.	`\${nodeText.noSymptomCode}`	
6.	<p>Determine which wireless antenna is damaged:</p> <p>A. Antenna going to antenna plate</p> <p>B. Antennas going to rear I/O wall</p> <p>Which wireless antenna is damaged?</p>	A	<p>Replace the antenna plate.</p> <p>Verify that the issue is resolved.</p>	X03	PIECE PART
		B	<p>Replace the rear I/O wall.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
7.	<p>With the antenna cables unplugged, inspect the wireless antenna cable connectors on the logic board for housing or pin damage.</p> <p>Do the antenna connectors on the logic board show signs of damage?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	
8.	<p>Reseat the antenna cable connectors to the logic board, then connect to a known-good Wi-Fi network.</p> <p>Is the computer able to connect to a known-good Wi-Fi network?</p>	Yes	The issue was resolved by reseating the wireless antenna connectors to the logic board. Verify that the issue is resolved.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 9.	`\${nodeText.noSymptomCode}`	
9.	<p>Troubleshooting this issue completely requires the following known-good parts:</p> <ul style="list-style-type: none"> • Antenna plate • Rear I/O wall <p>Do you have immediate access to each of these known-good parts?</p>	Yes	Go to step 10.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the antenna plate.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC
10.	<p>Substitute known-good antenna plate, then connect to a known-good Wi-Fi network.</p> <p>Is the computer able to connect to a known-good Wi-Fi network?</p>	Yes	<p>Replace the antenna plate.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC
		No	Go to step 11.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
11.	Substitute known-good rear I/O wall, then retry pairing with a known-good Bluetooth device. Is the computer able to pair with a known-good Bluetooth device?	Yes	Replace the rear I/O wall. Verify that the issue is resolved.	X03	OTHER ELECTRIC
		No	Go to step 12.	\${nodeText.noSymptomCode}	
12.	Determine if the following symptom was observed on the user's computer: <ul style="list-style-type: none"> No Wi-Fi signal. Does this symptom accurately describe the user's issue?	Yes	Reinstall the user's rear I/O wall and antenna plate. Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M40	MLB
		No	Go to step 13.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
13.	<p>Determine if the following symptom was observed on the user's computer:</p> <ul style="list-style-type: none"> Cannot connect to a known-good Wi-Fi network. <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Reinstall the user's rear I/O wall and antenna plate.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M41	MLB
		No	Go to step 14.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
14.	<p>Determine if the following symptom was observed on the user's computer:</p> <ul style="list-style-type: none"> Onboard Wi-Fi Performance issue. <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Reinstall the user's rear I/O wall and antenna plate.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M42	MLB
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
15.	<p>Connect to a known-good wireless network and retest data throughput, checking for adequate transfer speeds.</p> <p>Verify that wireless connection is sustained for several minutes.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Audio Input Issues

Unlikely causes:

Antenna plate, bottom cover, fan, housing, memory, power supply, rear I/O wall, sleep indicator light, speaker.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Audio input port does not function, but audio output is functionalAudio input port produces distorted audioAudio input port cannot be selected <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">The audio input port on this computer supports analog audio input signals only. The audio input port on this computer does not support optical audio connections such as TOSLink.Verify that nothing is inserted into the audio input port on the user's computer. Use an otoscope to visually inspect the port.Connect known-good Apple EarPods with 3.5 mm Headphone Plug to the audio input port on the user's computer. Verify that the 3.5 mm stereo plug is seated fully in the port.Go to System Preferences > Sound, and verify the following:<ul style="list-style-type: none">Input tab:<ul style="list-style-type: none">External Microphone is available and selected for sound input."Input volume" is not set to zero.Output tab:<ul style="list-style-type: none">Internal Speaker is available and selected for sound output."Output volume" is not muted or set to zero.Go to System Preferences > Sound > Input tab, and verify that the "Input level" indicator moves when speaking into the EarPod's microphone.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Inspect the audio port and rear I/O wall opening on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use an otoscope to visually inspect the port.	Yes	Go to step 2.	<code>\${nodeText.yesSymptomCode}</code>	
	Important: Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.	No	Go to step 3.	<code>\${nodeText.noSymptomCode}</code>	
	Is the audio port damaged?				

	Check	Result	Action	Code	Commodity
2.	<p>Inspect the opening on the rear I/O wall for the damaged audio port. Determine whether the opening is misshapen or deformed, preventing proper insertion of a 3.5 mm stereo plug.</p> <p>Is the opening for the audio port damaged or deformed?</p>	Yes	<p>Replace the rear I/O wall.</p> <p>Verify that the issue is resolved.</p>	X13	OTHER ELECTRIC
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
3.	<p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Retest by going to System Preferences > Sound > Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Does the issue persist from a known-good OS?</p>	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.noSymptomCode)	
4.	<p>Run AST 2 Audio Interactive test suite to verify that the computer's audio input port detects expected audio test patterns produced from the speaker.</p> <p>Does the computer pass AST 2 Audio Interactive test suite?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	Go to step 5.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
5.	<p>Check that audio input connector is not obstructed with lint or debris. Attempt to clean any debris with an ESD-safe brush.</p> <p>Are you able to clean this connector?</p>	Yes	Go to step 6.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M09	MLB
6.	<p>Run AST 2 Audio Interactive test suite to verify that the audio input port detects expected audio test patterns produced from the speaker.</p> <p>Does the computer pass AST 2 Audio Interactive test suite?</p>	Yes	The issue was resolved by cleaning the audio input port.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M09	MLB

	Check	Result	Action	Code	Commodity
7.	Verify that external audio input is available, selected, and functional, and that the “Input level” indicator moves when speaking into a connected microphone. Then record a sample audio file and play it back to verify that it is free of distortion.	Yes	The issue is resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
	<p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Distorted Audio from Internal Speaker

Unlikely causes:

Antenna plate, bottom cover, fan, housing, memory, power supply, rear I/O wall, sleep indicator light.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Sound is distorted, fuzzy, or crackly• Symptom only occurs with internal speaker• Symptom only occurs with external speakers or headphones <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Test with a known-good sound file.2. Compare the same sound and settings against a known-good computer of the same type to confirm that the sound is distorting.3. In System Preferences > Sound > Output, adjust the Output volume.4. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.5. If testing using iTunes, check that the equalizer is not turned on.6. Test the audio output using more than one application or website.7. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer.	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
	Start up the computer to a known-good external macOS startup volume. Attempt to reproduce the audio issue. Does the issue persist with known-good macOS?	No	Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.	\$(nodeText.noSymptomCode)	
2.	Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac .	Yes	Issue resolved by resetting NVRAM. Verify resolution.	\$(nodeText.yesSymptomCode)	
	In System Preferences > Sound > Output, adjust Output volume and retest. Attempt to reproduce the audio issue. Is audio clear and distortion free through internal speaker and headphones or external speakers?	No	Go to step 3.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
3.	Play a known-good audio file through the internal speaker, then connect known-good headphones or external speakers and compare for distortion. Is the issue isolated to the internal speaker?	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
		No	Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M09	MLB
4.	Disconnect headphones or external speakers. Follow Service Guide procedures to open the computer and disconnect and remove the internal speaker. Inspect the speaker cable and connector, and its corresponding connector on the logic board for damage. Is damage found on logic board or speaker connectors, or the speaker cable?	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
		No	Go to step 6.	\${nodeText.noSymptomCode}	
5.	Determine whether there is damage to the speaker or its cable, the logic board, or to a combination of multiple components. Is the damage limited to the speaker?	Yes	Replace the speaker. Verify that the issue is resolved.	X03	OTHER ELECTRIC
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

	Check	Result	Action	Code	Commodity
6.	Inspect and carefully clean the speaker membrane using a soft tissue to remove dust, debris, and foreign material, such as metal fragments that easily adhere to magnetic speakers.	Yes	Issue resolved by cleaning speaker or reseating speaker connection. Verify resolution.	#{nodeText.yesSymptomCode}	
	Reinstall the speaker. Reseat and reconnect the speaker cable to the logic board.	No	Go to step 7.	#{nodeText.noSymptomCode}	
	Retest to verify you can hear audio through the internal speaker that is clear and distortion free.				
7.	Is audio through the internal speaker clear and distortion free?				
	Troubleshooting this issue completely requires a known-good speaker.	Yes	Go to step 8.	#{nodeText.yesSymptomCode}	
	Do you have immediate access to a known-good speaker?	No	Replace the speaker. Verify that the issue is resolved.	X09	OTHER ELECTRIC
8.	Substitute a known-good speaker and retest to verify you can hear audio through internal speaker that is clear and distortion free. Run AST 2 Audio Interactive test suite to verify that the internal speaker produces expected audio test patterns. Is audio through the internal speaker clear and distortion free?	Yes	Replace the speaker. Verify that the issue is resolved.	X09	OTHER ELECTRIC
		No	Reinstall the user's speaker. Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.	M09	MLB
			Verify that the issue is resolved.		

	Check	Result	Action	Code	Commodity
9.	Connect and disconnect headphones or external speakers. Verify that audio through both internal speaker and headphones or external speakers is clear and distortion free.	Yes	The issue is resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
	Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Is the issue resolved?	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

External Apple Bluetooth Peripherals

Unlikely causes:

There are no unlikely causes for this issue.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> Apple Bluetooth wireless keyboard, mouse, or trackpad is not recognized by known-good computer Apple Bluetooth wireless keyboard, mouse, or trackpad will not pair with known-good computer Apple Bluetooth wireless keyboard, mouse, or trackpad intermittently loses its connection Apple wireless keyboard has one or more of the following issues: <ul style="list-style-type: none"> No power Battery will not charge (for peripherals with embedded batteries) Swollen battery (for peripherals with embedded batteries) Battery runtime too short Will not turn off One or more keys do not work Keys seem to stick, do not respond properly, or respond slowly Wrong keyboard language Keys missing or falling off Paint wearing off of one or more keys Physical and/or cosmetic issues Apple wireless mouse has one or more of the following issues: <ul style="list-style-type: none"> No power Battery will not charge (for peripherals with embedded batteries) Swollen battery (for peripherals with embedded batteries) Battery runtime too short Will not turn off No mouse response Mouse click not recognized Mouse causes erratic cursor tracking Physical and/or cosmetic issues Apple wireless trackpad has one or more of the following issues: <ul style="list-style-type: none"> No power Battery will not charge (for peripherals with embedded batteries) Swollen battery (for peripherals with embedded batteries) Battery runtime too short Will not turn off No trackpad response Trackpad click not recognized Trackpad causes erratic cursor tracking Trackpad requires high click force Trackpad click overly sensitive Force Touch or haptic feedback issue Physical and/or cosmetic issues <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>Important: This troubleshooting procedure is intended only for Apple Bluetooth wireless peripheral devices, such as the following Apple products:</p> <ul style="list-style-type: none"> Magic Mouse or Magic Mouse 2 Magic Trackpad or Magic Trackpad 2 Apple Wireless Keyboard or Magic Keyboard <p>For simplicity, this procedure refers to these products as wireless mouse, wireless trackpad, and wireless keyboard unless otherwise noted.</p> <p>For third-party devices, contact the manufacturer for support, software/firmware updates, or service options.</p> <ol style="list-style-type: none"> Verify compatibility of the user's Apple wireless mouse, keyboard, or trackpad. Refer to HT201806: How to identify your Apple wireless mouse, keyboard, or trackpad. Check for and apply the latest software and firmware updates. In System Preferences, make sure Bluetooth is on and set to Discoverable. For Apple Bluetooth peripherals with replaceable batteries, such as Magic Mouse, Magic Trackpad, or Apple Wireless Keyboard: If the device does not turn on, then install new or fully charged batteries. For Apple Bluetooth peripherals with embedded batteries, such as Magic Mouse 2, Magic Trackpad 2, or Magic Keyboard: If the device does not turn on, then connect a known-good USB Power Adapter and Lightning cable to the device to charge it for at least two minutes. Switching the device on/off button or switch to the on position will allow the device to charge more quickly than when off. For Apple Bluetooth peripherals with embedded batteries such as Magic Mouse 2, Magic Trackpad 2, or Magic Keyboard, verify that the computer being used with the peripheral supports Bluetooth 4.0 or later. Computers with earlier versions of Bluetooth support will not pair with Apple Bluetooth peripherals with embedded batteries. Reset Bluetooth device or delete pairing (if applicable). If Bluetooth pairs normally at your service location, then research potential sources of interference in the user's environment, such as microwave ovens or cordless phones in the 2.4/5GHz range. See article HT201542: Potential sources of Wi-Fi and Bluetooth interference. Magic Mouse 2, Magic Trackpad 2, and Magic Keyboard can pair with the computer using either Bluetooth or a Lightning cable. If Bluetooth pairing is not possible due to interference or other reasons, then try pairing these products by connecting them to the known-good computer with a known-good Lightning cable. Refer to HT201178: Set up your Apple wireless mouse, keyboard, and trackpad. For keyboard issues, refer to HT204540: If your Apple keyboard doesn't work and HT203162: One or more keys on the keyboard do not respond for troubleshooting tips.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Visually inspect the user's wireless mouse, wireless trackpad, or wireless keyboard for any physical, cosmetic, and liquid damage.</p> <p>On a wireless mouse or wireless trackpad, verify that the mouse or trackpad button clicks.</p> <p>On keyboards, verify that all keyboard buttons are present and can be depressed normally.</p> <p>Does the user's wireless mouse, wireless trackpad, or wireless keyboard show signs of damage?</p>	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
2.	<p>Determine whether there is a safety issue, such as fumes, excessive heat, or shock.</p> <p>Do not perform procedures that can be a safety risk to you or the user.</p> <p>Can you proceed safely?</p>	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support regarding safety procedures for this product.</p>	\$(nodeText.noSymptomCode)	
3.	<p>Isolate damage issue to either user's wireless keyboard or wireless mouse or trackpad.</p> <p>Which peripheral is damaged?</p>	Wireless keyboard	Go to step 4.	\$(nodeText.yesSymptomCode)	
		Wireless mouse or trackpad	Go to step 8.	\$(nodeText.noSymptomCode)	
4.	<p>Closely examine the user's device to determine exact nature of the issue.</p> <p>Look for any signs of liquid spill, liquid penetration, or liquid damage to device.</p> <p>Is damage to user's device related to liquid spill?</p>	Yes	Replace the user's wireless keyboard out of warranty.	K90	KEYBOARD
		No	Go to step 5.	\$(nodeText.noSymptomCode)	
5.	<p>Closely examine the user's device for any signs of physical damage that may affect operation.</p> <p>Does the user's device exhibit this symptom?</p>	Yes	Replace the user's wireless keyboard out of warranty.	K16	KEYBOARD
		No	Go to step 6.	\$(nodeText.noSymptomCode)	
6.	<p>Closely examine the user's device for signs of paint wearing off of one or more keys.</p> <p>Does the user's device exhibit this symptom?</p>	Yes	Replace the user's wireless keyboard out of warranty.	K35	KEYBOARD
		No	Go to step 7.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
7.	Closely examine the user's device for any signs of cosmetic damage that does not affect operation.	Yes	Replace the user's wireless keyboard out of warranty.	K21	KEYBOARD
	Does the user's device exhibit this symptom?	No	Issue cannot be duplicated.	\$(nodeText.noSymptomCode)	
8.	Closely examine the user's device to determine exact nature of the issue.	Yes	Replace the user's wireless mouse or wireless trackpad out of warranty.	K90	MOUSE
	Look for any signs of liquid spill, liquid penetration, or liquid damage to device.	No	Go to step 9.	\$(nodeText.noSymptomCode)	
	Is damage to user's device related to liquid spill?				
9.	Closely examine the user's device for any signs of physical damage that may affect operation.	Yes	Replace the user's wireless mouse or wireless trackpad out of warranty.	K16	MOUSE
	Does the user's device exhibit this symptom?	No	Go to step 10.	\$(nodeText.noSymptomCode)	
10.	Closely examine the user's device for any signs of cosmetic damage that does not affect operation.	Yes	Replace the user's wireless mouse or wireless trackpad out of warranty.	K21	MOUSE
	Does the user's device exhibit this symptom?	No	Issue cannot be duplicated.	\$(nodeText.noSymptomCode)	
11.	Follow steps listed in HT201171: Using a Bluetooth mouse, keyboard, or trackpad with your Mac to pair the user's Bluetooth device with a known-good Mac.	Yes	ESCALATION REQUIRED. The Bluetooth device appears to be performing to specifications. There may be an issue with the user's computer, or wireless interference in user's environment. If issue persists, then contact ACS for additional support.	\$(nodeText.yesSymptomCode)	
	Test the user's wireless mouse, wireless trackpad, or wireless keyboard manually, using built-in applications on a known-good Mac. For example, use the Notes application to check the keys on a wireless keyboard.				
	Refer to HT204621: If your Apple wireless mouse, keyboard, or trackpad aren't working as expected for tips to resolve issues.				
12.	Does the user's wireless mouse, wireless trackpad, or wireless keyboard pair and function normally?	No	Go to step 12.	\$(nodeText.noSymptomCode)	
	Isolate failure to either user's wireless keyboard or wireless mouse or trackpad.	Wireless keyboard	Go to step 13.	\$(nodeText.yesSymptomCode)	
	Which peripheral is malfunctioning?	Wireless mouse or trackpad	Go to step 29.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
13.	Look for for any signs of power on the user's wireless keyboard, such as a power LED turning on. Note: Not all devices have a power LED.	Yes	Go to step 14.	\${nodeText.yesSymptomCode}	
	Verify that the user's wireless keyboard turns ON when the on/off button or switch is placed in the on position. Verify that the user's wireless keyboard turns off when the on/off button or switch is placed in the off position. Does the user's wireless keyboard exhibit any power-related symptoms?	No	Go to step 18.	\${nodeText.noSymptomCode}	
14.	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard is not functioning at all (seems dead, no power, power LED does not turn on) 	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K09	KEYBOARD
	Does the user's wireless keyboard exhibit this symptom?	No	Go to step 15.	\${nodeText.noSymptomCode}	
15.	Verify that the user's wireless keyboard turns on when the on/off button or switch is placed in the on position. Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> On/off switch or button is defective 	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K19	KEYBOARD
	Does the user's wireless keyboard exhibit this symptom?	No	Go to step 16.	\${nodeText.noSymptomCode}	
16.	Verify that the user's wireless keyboard turns off when the on/off button or switch is placed in the off position. Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard remains on when the on/off button or switch has been placed in the off position 	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K34	KEYBOARD
	Does the user's wireless keyboard exhibit this symptom?	No	Go to step 17.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
17.	Verify if the user's wireless keyboard has any other power-related issue that is not related to the on/off button or switch.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K20	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> Power Issue, not due to on/off button or switch Does the user's wireless keyboard exhibit this symptom?	No	Go to step 18.	\${nodeText.noSymptomCode}	
18.	If the user's issue involves pairing or connecting to a Magic Keyboard, then you can connect to, pair, and use this device with the computer using either Bluetooth or a Lightning cable.	Yes	Go to step 19.	\${nodeText.yesSymptomCode}	
	If Bluetooth pairing is not possible due to interference or other reasons, then try connecting the user's Magic Keyboard to the known-good computer with a known-good Lightning cable. For other Apple Bluetooth peripherals, select the "Yes" answer to continue. Does the user's Magic Keyboard connect and pair using USB?	No	Replace the user's wireless keyboard. Verify that the issue is resolved.	K30	KEYBOARD
19.	Verify that the known-good computer can recognize the user's wireless keyboard.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K15	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard is not recognized by known-good computer Does the user's wireless keyboard exhibit this symptom?	No	Go to step 20.	\${nodeText.noSymptomCode}	
20.	Verify that the known-good computer can pair with the user's wireless keyboard using Bluetooth.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K07	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard cannot pair with a known-good computer Does the user's wireless keyboard exhibit this symptom?	No	Go to step 21.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
21.	Verify that the known-good computer maintains a Bluetooth connection to the user's wireless keyboard, and does not drop this connection.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K08	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none">User's wireless keyboard intermittently loses its connection with a known-good computer	No	Go to step 22.	`\${nodeText.noSymptomCode}`	
	Does the user's wireless keyboard exhibit this symptom?				
22.	Ask the user how often and how long the wireless keyboard is used.	Yes	Go to step 23.	`\${nodeText.yesSymptomCode}`	
	Explain to the user that the battery issue could likely be caused by the user using the wireless keyboard continuously over a long period of time, rather than any fault of the wireless keyboard itself, macOS, or the user's computer.				
	Gain agreement from the user that lengthy wireless keyboard usage is likely to be the cause of the battery life issue, and that there is no service issue with the wireless keyboard itself.	No	Replace the user's wireless keyboard. Verify that the issue is resolved.	K32	KEYBOARD
	Does the user agree that the battery life issue is likely caused by lengthy wireless keyboard usage?				
23.	Attempt to charge the user's wireless keyboard battery for several more minutes. Verify that the user's wireless keyboard battery charge level that appears on the known-good computer that is paired with this user's wireless keyboard has increased and shows that the user's wireless keyboard is charging.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K31	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none">User's wireless keyboard battery will not charge Note: This symptom does not apply to peripherals with replaceable batteries.	No	Go to step 24.	`\${nodeText.noSymptomCode}`	
	Does the user's wireless keyboard exhibit this symptom?				

	Check	Result	Action	Code	Commodity
24.	Closely inspect the user's wireless keyboard enclosure for signs of a swollen battery.	Yes	Replace the user's wireless keyboard.	K33	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard battery appears swollen <p>Note: This symptom does not apply to peripherals with replaceable batteries.</p> <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Go to step 25.	\$(nodeText.noSymptomCode)	
25.	Verify that each and every wireless keyboard key functions as expected when pressed and released.	Yes	Replace the user's wireless keyboard.	K01	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> One or more keys do not work <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Go to step 26.	\$(nodeText.noSymptomCode)	
26.	Verify that each and every wireless keyboard key functions as expected when pressed and released.	Yes	Replace the user's wireless keyboard.	K05	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> Keys seem to stick, do not respond properly, or respond slowly <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Go to step 27.	\$(nodeText.noSymptomCode)	
27.	Verify that each and every wireless keyboard key is intact and not missing.	Yes	Replace the user's wireless keyboard.	K27	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> Keys missing or falling off <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Go to step 28.	\$(nodeText.noSymptomCode)	
28.	Verify that the wireless keyboard language is as expected.	Yes	Replace the user's wireless keyboard.	K04	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> Wrong keyboard language version <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Issue cannot be duplicated.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
29.	Look for for any signs of power on the user's wireless mouse or trackpad, such as a power LED turning on. Note: Not all devices have a power LED.	Yes	Go to step 30.	\${nodeText.yesSymptomCode}	
	Verify that the user's wireless mouse or trackpad turns on when the on/off button or switch is placed in the on position.	No	Go to step 34.	\${nodeText.noSymptomCode}	
	Verify that the user's wireless mouse or trackpad turns off when the on/off button or switch is placed in the off position.				
	Does the user's wireless mouse or trackpad exhibit any power-related symptoms?				
30.	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad is not functioning at all (seems dead, no power, power LED does not turn on) 	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K09	MOUSE
	Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 31.	\${nodeText.noSymptomCode}	
31.	Verify that the user's wireless mouse or trackpad turns on when the on/off button or switch is placed in the on position.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K19	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> on/off switch or button is defective 	No	Go to step 32.	\${nodeText.noSymptomCode}	
	Does the user's wireless mouse or trackpad exhibit this symptom?				
32.	Verify that the user's wireless mouse or trackpad turns off when the on/off button or switch is placed in the off position.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K34	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad remains on when the on/off button or switch has been placed in the off position 	No	Go to step 33.	\${nodeText.noSymptomCode}	
	Does the user's wireless mouse or trackpad exhibit this symptom?				

	Check	Result	Action	Code	Commodity
33.	Verify if the user's wireless mouse or trackpad has any other power-related issue that is not related to the on/off button or switch.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K20	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> Power Issue, not due to on/off button or switch Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 34.	\$(nodeText.noSymptomCode)	
34.	If the user's issue involves pairing or connecting to a Magic Mouse 2 or Magic Trackpad 2, then you can connect to and pair these devices with a computer using either Bluetooth or a Lightning cable.	Yes	Go to step 35.	\$(nodeText.yesSymptomCode)	
	If Bluetooth pairing is not possible due to interference or other reasons, then try connecting the user's Magic Mouse 2 or Magic Trackpad 2 to a known-good computer with a known-good Lightning cable. For other Apple Bluetooth peripherals, select the "Yes" answer to continue. Does the user's Magic Mouse 2 or Magic Trackpad 2 connect and pair using USB?	No	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K30	MOUSE
35.	Verify that the known-good computer can recognize the user's wireless mouse or trackpad.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K15	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad is not recognized by known-good computer. Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 36.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
36.	Verify that the known-good computer can pair with the user's wireless mouse or trackpad.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K07	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad cannot pair with a known-good computer Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 37.	\$(nodeText.noSymptomCode)	
37.	Verify that the known-good computer maintains a Bluetooth connection to the user's wireless mouse or trackpad, and does not drop this connection.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K08	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad intermittently loses its connection with a known-good computer Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 38.	\$(nodeText.noSymptomCode)	
38.	Ask the user how often and how long the wireless mouse or trackpad is used.	Yes	Go to step 39.	\$(nodeText.yesSymptomCode)	
	Gain agreement from the user that lengthy wireless mouse or trackpad usage is likely to be the cause of the battery life issue, and that there is no service issue with the wireless mouse or trackpad itself. Does the user agree that the battery life issue is likely caused by lengthy wireless device usage?	No	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K32	MOUSE

	Check	Result	Action	Code	Commodity
39.	Attempt to charge the user's wireless mouse or trackpad battery for several more minutes. Verify that the user's wireless mouse or trackpad battery charge level that appears on the known-good computer that is paired with this user's wireless mouse or trackpad has increased and shows that the user's wireless mouse or trackpad is charging.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K31	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad battery will not charge <p>Note: This symptom does not apply to peripherals with replaceable batteries.</p> <p>Does the user's wireless mouse or trackpad exhibit this symptom?</p>	No	Go to step 40.	\$(nodeText.noSymptomCode)	
40.	Closely inspect the user's wireless mouse or trackpad enclosure for signs of a swollen battery.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K33	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad battery appears swollen <p>Note: This symptom does not apply to peripherals with replaceable batteries.</p> <p>Does the user's wireless mouse or trackpad exhibit this symptom?</p>	No	Go to step 41.	\$(nodeText.noSymptomCode)	
41.	Isolate failure to either user's wireless mouse or wireless trackpad.	Wireless mouse	Go to step 42.	\$(nodeText.yesSymptomCode)	
	Which peripheral is malfunctioning?	Wireless trackpad	Go to step 45.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
42.	Verify that the overall function of the user's wireless mouse performs as expected when used with the known-good computer.	Yes	Replace the user's wireless mouse. Verify that the issue is resolved.	K26	MOUSE
	Confirm that the issue with the user's wireless mouse is: <ul style="list-style-type: none"> No mouse response Does the user's wireless mouse exhibit this symptom?	No	Go to step 43.	\$(nodeText.noSymptomCode)	
43.	Verify that the clicking function of the user's wireless mouse performs as expected when pressed and released.	Yes	Replace the user's wireless mouse. Verify that the issue is resolved.	K14	MOUSE
	Confirm that the issue with the user's wireless mouse is: <ul style="list-style-type: none"> Mouse clicking function not working properly Does the user's wireless mouse exhibit this symptom?	No	Go to step 44.	\$(nodeText.noSymptomCode)	
44.	Verify that the touch gesture function of the user's wireless mouse performs as expected when the mouse surface is touched.	Yes	Replace the user's wireless mouse. Verify that the issue is resolved.	K18	MOUSE
	Confirm that the issue with the user's wireless mouse is: <ul style="list-style-type: none"> Touch/Multi-Touch gesture issue Does the user's wireless mouse exhibit this symptom?	No	Issue cannot be duplicated.	\$(nodeText.noSymptomCode)	
45.	Verify that the overall function of the user's wireless trackpad performs as expected when used with the known-good computer.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K23	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad cursor not responding Does the user's wireless trackpad exhibit this symptom?	No	Go to step 46.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
46.	Verify that the user's wireless trackpad exhibits smooth continuous tracking when used with the known-good computer, and does not skip or behave erratically.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K12	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad cursor not tracking properly Does the user's wireless trackpad exhibit this symptom?	No	Go to step 47.	\$(nodeText.noSymptomCode)	
47.	Verify that the clicking function of the user's wireless trackpad performs as expected when pressed and released, and that the click is recognized by the known-good computer.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K13	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad click not recognized Does the user's wireless trackpad exhibit this symptom?	No	Go to step 48.	\$(nodeText.noSymptomCode)	
48.	Verify that the user's wireless trackpad clicking function does not require excessive force when pressed and released.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K24	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad requires high click force Does the user's wireless trackpad exhibit this symptom?	No	Go to step 49.	\$(nodeText.noSymptomCode)	
49.	Verify that the user's wireless trackpad clicking function is not overly sensitive to clicking when pressed and released.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K25	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad click oversensitive Does the user's wireless trackpad exhibit this symptom?	No	Go to step 50.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
50.	Verify that the user's wireless trackpad Force Touch function performs as expected and that haptic feedback is felt in response. Note: This feature does not apply to all models.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K29	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad Force Touch or haptic feedback issue 	No	Issue cannot be duplicated.	<code> \${nodeText.noSymptomCode} </code>	
	Does the user's wireless trackpad exhibit this symptom?				

External Apple Wired Keyboard and Mouse

Unlikely causes:

There are no unlikely causes for this issue.

Quick Check

Symptoms	Quick Check
<p>Apple wired USB keyboard or mouse does not function with user's computer or shows one or more of the following symptoms:</p> <ul style="list-style-type: none">• One or more mouse buttons do not click• Mouse scroll ball does not operate smoothly• No mouse response• Keys stick• Keys loose or missing• One or more keys do not respond when pressed• No keyboard response at all• Apple wired mouse causes erratic cursor tracking• Apple wired keyboard or mouse is not recognized• Apple wired keyboard or mouse has physical damage that affects operation• Paint wearing off of one or more keys• Apple wired keyboard or mouse has cosmetic damage that does not affect operation <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Disconnect all USB devices from the user's computer except for the user's mouse or keyboard. Troubleshoot only one device at a time to help isolate the issue.2. Unplug the keyboard or mouse from the USB port, wait a few seconds, and reconnect it.3. Connect the keyboard or mouse to another USB port on the user's computer.4. Make sure the USB connectors are plugged in completely and correctly.5. Visually inspect the USB connectors and ports for damage or debris.6. Try operating the user's mouse on another surface. Ask the user about the type of surface usually being used with the mouse. Glossy or transparent surfaces, or those with repetitive patterns, may cause mouse-tracking errors or faulty mouse operation. Explain that solid, nonreflective, opaque surfaces work best. The surface should be clean, but not shiny.7. Visually inspect the user's keyboard or mouse for dirt, hair, liquid damage, or other debris. Check to see if the user has pets. Pet hair can lie across the laser and cause intermittent mouse issues. Refer to article HT204172: How to clean your Apple products for information on cleaning the user's keyboard or mouse.8. Connect the user's USB keyboard or mouse to an available USB port on a known-good computer to determine if the issue is related to the USB port on the user's computer, or to the user's USB keyboard or mouse. If the user's keyboard or mouse functions when used with the known-good computer, go to the “USB Port Not Recognized” troubleshooting flow.9. For keyboard issues, refer to HT204540: If your Apple keyboard doesn't work and HT203162: One or more keys on the keyboard do not respond for troubleshooting tips.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Visually inspect the user's USB mouse or keyboard to verify that the attached USB cable and connector are not damaged or frayed.</p> <p>Check user's keyboard or mouse for physical and liquid damage.</p> <p>On mice, verify that all mouse buttons click and laser tracking LED illuminates.</p> <p>On keyboards, verify that all keys are present and can be depressed normally.</p> <p>Does the user's USB mouse or keyboard, or its attached cable or connector, show signs of damage?</p>	Yes	Go to step 2.	\${nodeText.yesSymptomCode}	
		No	Go to step 12.	\${nodeText.noSymptomCode}	
2.	<p>Isolate damage issue to either user's wired USB keyboard or mouse.</p> <p>Which peripheral is damaged?</p>	USB Keyboard	Go to step 3.	\${nodeText.yesSymptomCode}	
		USB Mouse	Go to step 9.	\${nodeText.noSymptomCode}	
3.	<p>Closely examine user's keyboard to determine exact nature of the issue.</p> <p>Look for any signs of liquid spill, liquid penetration, and liquid damage to keyboard.</p> <p>Is damage to user's keyboard related to liquid spill?</p>	Yes	<p>Replace USB keyboard. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K90	KEYBOARD
		No	Go to step 4.	\${nodeText.noSymptomCode}	
4.	<p>Click each key to ensure no keys are sticking in the down or up position.</p> <p>Is damage to user's keyboard related to sticky keys or slow key response?</p>	Yes	<p>Replace USB keyboard. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K05	KEYBOARD
		No	Go to step 5.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	Look for any loose or missing keycaps. Is damage to user's keyboard related to loose or missing keycaps?	Yes	Replace USB keyboard. Verify issue resolved. Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K27	KEYBOARD
		No	Go to step 6.	\${nodeText.noSymptomCode}	
6.	Closely inspect the keyboard for any signs of physical damage that may affect operation. Does the user's keyboard exhibit this symptom?	Yes	Replace USB keyboard. Verify issue resolved. Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K16	KEYBOARD
		No	Go to Step 7.	\${nodeText.noSymptomCode}	
7.	Closely examine the keyboard for signs of paint wearing off of one or more keys. Does the user's keyboard exhibit this symptom?	Yes	Replace USB keyboard. Verify issue resolved. Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K35	KEYBOARD
		No	Go to step 8.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
8.	<p>Closely inspect the keyboard for any signs of cosmetic damage that does not affect operation.</p> <p>Does the user's keyboard exhibit this symptom?</p>	Yes	<p>Replace USB keyboard. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K21	KEYBOARD
		No	Issue cannot be duplicated.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	
9.	<p>Closely examine user's mouse to determine exact nature of the issue.</p> <p>Look for any signs of liquid spill, liquid penetration, and liquid damage to mouse.</p> <p>Is damage to user's mouse related to liquid spill?</p>	Yes	<p>Replace USB mouse. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K90	MOUSE
		No	Go to step 10.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	
10.	<p>Closely inspect the mouse for any signs of physical damage that may affect operation.</p> <p>Is there physical damage to user's mouse?</p>	Yes	<p>Replace USB mouse. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K16	MOUSE
		No	Go to step 11.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	

	Check	Result	Action	Code	Commodity
11.	Closely inspect the mouse for any signs of cosmetic damage that does not affect operation.	Yes	Replace USB mouse. Verify issue resolved. Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K21	MOUSE
	Is there cosmetic damage to user's mouse?	No	Issue cannot be duplicated.	\${nodeText.noSymptomCode}	
12.	Isolate failure issue to either user's wired USB keyboard or mouse.	USB Keyboard	Go to step 17.	\${nodeText.yesSymptomCode}	
	Which peripheral is malfunctioning?	USB Mouse	Gp to step 13.	\${nodeText.noSymptomCode}	
13.	Connect user's USB mouse to a free USB port on a known-good computer, and check System Information to determine whether the computer recognizes the mouse.	Yes	Go to step 14.	\${nodeText.yesSymptomCode}	
	Is mouse recognized by a known-good computer?	No	Replace USB mouse. Verify issue resolved.	K15	MOUSE
14.	Move the mouse and verify that the cursor on the known-good computer screen moves smoothly.	Yes	Replace USB mouse. Verify issue resolved.	K26	MOUSE
	Is issue related to mouse function?	No	Go to step 15.	\${nodeText.noSymptomCode}	
15.	Click and roll the mouse's scroll ball to check that it rolls freely in all directions and with no physical resistance.	Yes	Replace USB mouse. Verify issue resolved.	K06	MOUSE
	Is issue related to the scroll ball?	No	Go to step 16.	\${nodeText.noSymptomCode}	
16.	Press the mouse's various buttons to verify that they click properly, without sticking, every time they are pressed.	Yes	Replace USB mouse. Verify issue resolved.	K14	MOUSE
	Is issue related to the mouse button(s)?	No	Issue cannot be duplicated.	\${nodeText.noSymptomCode}	
17.	Connect user's USB keyboard to a free USB port on a known-good computer, and check System Information to determine whether the computer recognizes the keyboard.	Yes	Go to step 18.	\${nodeText.yesSymptomCode}	
	Is keyboard recognized by a known-good computer?	No	Replace USB keyboard. Verify issue resolved.	K15	KEYBOARD

	Check	Result	Action	Code	Commodity
18.	Verify that all keys functions as expected when pressed and released.	Yes	Replace USB keyboard. Verify issue resolved.	K01	KEYBOARD
	Is issue related to specific keys not working?	No	Go to step 19.	\${nodeText.noSymptomCode}	
19.	Verify that the keyboard language is as expected.	Yes	Replace USB keyboard. Verify issue resolved.	K04	KEYBOARD
	Is issue related to keyboard language?	No	Issue cannot be duplicated.	\${nodeText.noSymptomCode}	

No Audio from Internal Speaker or Headphone Jack

Unlikely causes:

Antenna plate, bottom cover, fan, housing, memory, power supply, rear I/O wall, sleep indicator light.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">No sound from internal speakerNo sound from headphone jack <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">The audio output port (headphone jack) on this computer supports analog audio output signals only. The audio output port on this computer does not support optical audio connections such as TOSLink.Test with a known-good sound file.In System Preferences > Sound > Output, adjust the Output volume.In System Preferences > Sound > Output, verify "Internal Speaker" output is available and selected.Connect headphones or external speakers to audio output port. From System Preferences > Sound > Output, verify Audio Out setting switches to "Headphones." Verify sound can be heard through headphones or external speakers.Disconnect any device connected to audio output port. From System Preferences > Sound > Output, verify Audio Out setting reverts to "Internal Speaker." Use Volume slider to verify issue is isolated to internal speaker.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Test the audio output using more than one application or website.Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	Start up the computer to a known-good external macOS startup volume. Attempt to reproduce the audio issue. Does the issue persist with known-good macOS?	No	Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
2.	Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac .	Yes	Issue resolved by resetting NVRAM. Verify resolution.	\${nodeText.yesSymptomCode}	
	In System Preferences > Sound > Output, adjust Output volume and retest. Attempt to reproduce the audio issue. Is audio emitted through internal speaker and headphones or external speakers?	No	Go to step 3.	\${nodeText.noSymptomCode}	
3.	Play a known-good audio file through the internal speaker, then connect known-good headphones or external speakers and compare output. Is the issue isolated to the internal speaker?	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
		No	Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M09	MLB
4.	Disconnect headphones or external speakers.	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
	Follow Service Guide procedures to disconnect and remove the internal speaker. Inspect the speaker cable and connector, and its corresponding connector on the logic board for damage. Is damage found on logic board or speaker connectors, or the speaker cable?	No	Go to step 6.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	Determine whether there is damage to the speaker or its cable, the logic board, or to a combination of multiple components.	Yes	Replace the speaker. Verify that the issue is resolved.	X03	OTHER ELECTRIC
	Is the damage limited to the speaker?	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
6.	Reinstall the speaker. Reseat and reconnect the speaker cable to the logic board.	Yes	Issue resolved by reseating speaker connection. Verify resolution.	\${nodeText.yesSymptomCode}	
	Retest to verify you can hear sound through the internal speaker. Is sound emitted through the internal speaker?	No	Go to step 7.	\${nodeText.noSymptomCode}	
7.	Troubleshooting this issue completely requires a known-good speaker.	Yes	Go to step 8.	\${nodeText.yesSymptomCode}	
	Do you have immediate access to a known-good speaker?	No	Replace the speaker. Verify that the issue is resolved.	X08	OTHER ELECTRIC
8.	Substitute a known-good speaker and retest to verify you can hear sound through the internal speaker. Run AST 2 Audio Interactive test suite to verify that the internal speaker produces expected audio test patterns. Is sound emitted through internal speaker?	Yes	Replace the speaker. Verify that the issue is resolved.	X08	OTHER ELECTRIC
		No	Reinstall the user's speaker. Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M09	MLB

	Check	Result	Action	Code	Commodity
9.	Connect and disconnect headphones or external speakers. Verify that audio through both internal speaker and headphones or external speakers is clear and distortion free.	Yes	The issue is resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
	Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Is the issue resolved?	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

No Audio to External Display Speakers

Unlikely causes:

Antenna plate, bottom cover, fan, housing, logic board, memory, power supply, rear I/O wall, sleep indicator light, speaker.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Video but no audio to external display; audio works on internal speakers <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Gather display type and model information from the user.2. From System Preferences > Sound > Output, select “Internal Speakers.” Play audio file to verify internal speaker functionality.3. Verify computer using a known-good compatible Thunderbolt or HDMI display equipped with internal speakers, a known-good HDMI or Thunderbolt cable, and a known-good USB-C Digital AV Multiport Adapter.4. If you are testing with an HDMI display, verify that the correct input has been selected.5. If you are testing with a Thunderbolt Display, connect the Thunderbolt cable or USB-C Digital AV Multiport Adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user’s computer.6. From System Preferences > Sound > Output, select available “DisplayPort” or “HDMI” output device type (depending on display model and connection).7. From System Preferences > Sound > Output, adjust output volume.8. Test the audio output using more than one application or website.9. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.10. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.11. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates.12. Refer to the following articles to learn more about Thunderbolt connectivity in this computer:<ul style="list-style-type: none">• HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac• HT202488: About Apple Thunderbolt cables and adapters

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect the known-good display and HDMI cable (or Thunderbolt cable, depending on display) to the user's computer. Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Start up the computer to a known-good external macOS startup volume. In System Preferences > Sound > Output, check for an available HDMI or Thunderbolt device for sound output. Select the available device, adjust the volume level on the display, and play the audio file or source. Can the external display audio be selected and play audio from a known-good OS?	Yes	Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.	`\${nodeText.yesSymptomCode}`	
	No	Go to step 2.	`\${nodeText.noSymptomCode}`		
2.	Determine which computer port the user connects to an external display: A. HDMI B. USB-C Thunderbolt (with or without an adapter) Which port does the user connect to an external display?	A	Go to step 3.	`\${nodeText.yesSymptomCode}`	
	B	Go to step 7.	`\${nodeText.noSymptomCode}`		
3.	Inspect the HDMI port and rear I/O wall opening on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris. Important: Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage. Is the HDMI port damaged?	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
	No	Go to step 5.	`\${nodeText.noSymptomCode}`		

	Check	Result	Action	Code	Commodity
4.	<p>Inspect the opening on the rear I/O wall for the damaged HDMI port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the HDMI plug.</p> <p>Is the opening for the HDMI port damaged or deformed?</p>	Yes	<p>Replace the rear I/O wall.</p> <p>Verify that the issue is resolved.</p>	X13	OTHER ELECTRIC
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
5.	<p>Connect a known-good HDMI display and HDMI cable to the user's computer.</p> <p>In System Preferences > Sound > Output, check for an available HDMI device for sound output. Select the available device, adjust the volume level on the display, and play the audio file or source.</p> <p>Can the external display audio be selected and play audio from the user's computer?</p>	Yes	Go to step 6.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M28	MLB

	Check	Result	Action	Code	Commodity
6.	<p>Connect a known-good HDMI display an the user's HDMI cable to the user's computer.</p> <p>In System Preferences > Sound > Output, check for an available HDMI device for sound output. Select the available device, adjust the volume level on the display, and play the audio file or source.</p> <p>Can the external display audio be selected and play audio from the user's computer?</p>	Yes	<p>The issue is isolated to the user's display or HDMI cable. Inform the user of findings and refer to HT204388: Connect to HDMI from your Mac for more information.</p>	`\${nodeText.yesSymptomCode}`	
		No	<p>The issue is isolated to the user's HDMI cable.</p> <p>Replace the user's HDMI cable.</p> <p>If user has third-party cable, refer to manufacturer for support.</p>	X03	EXTERNAL CABLE
7.	<p>Inspect all USB-C ports and rear I/O wall openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.</p> <p>Important: Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.</p> <p>Is any USB-C port damaged?</p>	Yes	Go to step 8.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 9.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
8.	<p>Inspect the opening on the rear I/O wall for the damaged USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB-C plug.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the rear I/O wall.</p> <p>Verify that the issue is resolved.</p>	X13	OTHER ELECTRIC
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
9.	<p>Connect the known-good Thunderbolt display and known-good Thunderbolt cable to one of the computer's USB-C ports.</p> <p>In System Preferences > Sound > Output, check for an available DisplayPort device for sound output. Select the available device, adjust the volume level on the display, and play the audio file or source.</p> <p>Repeat this process for all USB-C ports on the computer.</p> <p>Reply YES only if all USB-C ports play audio on the external display.</p> <p>Can the external display audio be selected and play from the user's computer, for all USB-C ports?</p>	Yes	Go to step 10.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M09	MLB

	Check	Result	Action	Code	Commodity
10.	<p>Connect the known-good Thunderbolt display and the user's Thunderbolt cable to one of the computer's USB-C ports.</p> <p>In System Preferences > Sound > Output, check for an available DisplayPort device for sound output. Select the available device, adjust the volume level on the display, and play the audio file or source.</p> <p>Can the external display audio be selected and play audio from the user's computer?</p>	Yes	Go to step 11.	#{nodeText.yesSymptomCode}	
		No	<p>The issue is isolated to the user's Thunderbolt cable.</p> <p>Replace the user's Thunderbolt cable.</p> <p>If user has third-party cable, refer to manufacturer for support.</p>	X03	EXTERNAL CABLE
11.	<p>Connect the known-good display and HDMI cable to the user's USB-C Digital AV Multiport Adapter, then to one of the computer's USB-C ports.</p> <p>In System Preferences > Sound > Output, check for an available DisplayPort device for sound output. Select the available device, adjust the volume level on the display, and play the audio file or source.</p> <p>Can the external display audio be selected and play audio from the user's computer?</p>	Yes	<p>The issue is isolated to the user's display. Inform the user of findings and refer to HT204388: Connect to HDMI from your Mac for more information.</p>	#{nodeText.yesSymptomCode}	
		No	<p>The issue is isolated to the user's adapter.</p> <p>Replace the user's USB-C Digital AV Multiport Adapter or USB-C Digital AV VGA Adapter.</p> <p>If user has third-party adapter, refer to manufacturer for support.</p>	X03	EXTERNAL CABLE
12.	<p>Play a known-good audio file or source and verify that the sound output to display speakers is functional.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	#{nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

No Video to External Display

Unlikely causes:

Antenna plate, bottom cover, fan, housing, logic board, memory, power supply, rear I/O wall, sleep indicator light, speaker.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">External display not detected by computerExternal display does not show any video, but internal display does <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Gather display type and model information from the user.2. Verify computer using a known-good compatible Thunderbolt or HDMI display equipped with internal speakers, a known-good HDMI or Thunderbolt cable, and a known-good USB-C Digital AV Multiport Adapter.3. If you are testing with an HDMI display, verify that the correct input has been selected.4. If you are testing with a Thunderbolt Display, connect the Thunderbolt cable or USB-C Digital AV Multiport Adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user's computer.5. Open System Information > Graphics/Displays, and verify that the connected display appears in the list of displays recognized by the user's computer.6. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.7. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.8. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates.9. Refer to the following articles to learn more about Thunderbolt connectivity in this computer:<ul style="list-style-type: none">• HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac• HT202488: About Apple Thunderbolt cables and adapters

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect the known-good display and HDMI cable (or Thunderbolt cable, depending on display) to the user's computer. Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Start up the computer to a known-good external macOS startup volume. Open System Information > Graphics/Displays, and verify that the connected display appears in the list of displays recognized by the user's computer. Does a good image appear on the external display?	Yes	Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.	`\${nodeText.yesSymptomCode}`	
	No	Go to step 2.	`\${nodeText.noSymptomCode}`		
2.	Determine which computer port the user connects to an external display: A. HDMI B. USB-C Thunderbolt (with or without an adapter) Which port does the user connect to an external display?	A	Go to step 3.	`\${nodeText.yesSymptomCode}`	
	B	Go to step 7.	`\${nodeText.noSymptomCode}`		
3.	Inspect the HDMI port and rear I/O wall opening on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris. Important: Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage. Is the HDMI port damaged?	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
	No	Go to step 5.	`\${nodeText.noSymptomCode}`		

	Check	Result	Action	Code	Commodity
4.	<p>Inspect the opening on the rear I/O wall for the damaged HDMI port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the HDMI plug.</p> <p>Is the opening for the HDMI port damaged or deformed?</p>	Yes	<p>Replace the rear I/O wall.</p> <p>Verify that the issue is resolved.</p>	X13	OTHER ELECTRIC
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
5.	<p>Connect a known-good HDMI display and HDMI cable to the user's computer.</p> <p>Open System Information > Graphics/Displays, and verify that the connected display appears in the list of displays recognized by the user's computer.</p> <p>Does a good image appear on the external display?</p>	Yes	Go to step 6.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M28	MLB

	Check	Result	Action	Code	Commodity
6.	<p>Connect a known-good HDMI display an the user's HDMI cable to the user's computer.</p> <p>Open System Information > Graphics/Displays, and verify that the connected display appears in the list of displays recognized by the user's computer.</p> <p>Does a good image appear on the external display?</p>	Yes	<p>The issue is isolated to the user's display. Inform the user of findings and refer to HT204388: Connect to HDMI from your Mac for more information.</p>	`\${nodeText.yesSymptomCode}`	
		No	<p>The issue is isolated to the user's HDMI cable.</p> <p>Replace the user's HDMI cable.</p> <p>If user has third-party cable, refer to manufacturer for support.</p>	X03	EXTERNAL CABLE
7.	<p>Inspect all USB-C ports and rear I/O wall openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.</p> <p>Important: Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.</p> <p>Is any USB-C port damaged?</p>	Yes	Go to step 8.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 9.	`\${nodeText.noSymptomCode}`	
8.	<p>Inspect the opening on the rear I/O wall for the damaged USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB-C plug.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the rear I/O wall.</p> <p>Verify that the issue is resolved.</p>	X13	OTHER ELECTRIC
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB

	Check	Result	Action	Code	Commodity
9.	<p>Connect the known-good Thunderbolt display and known-good Thunderbolt cable to one of the computer's USB-C ports.</p> <p>Open System Information > Graphics/Displays, and verify that the connected display appears in the list of displays recognized by the user's computer.</p> <p>Repeat this process for all USB-C ports on the computer.</p> <p>Reply YES only if all USB-C ports display a good image on the external display.</p> <p>Does a good image appear on the external display?</p>	Yes	Go to step 10.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M26	MLB
10.	<p>Connect the known-good Thunderbolt display and the user's Thunderbolt cable to one of the computer's USB-C ports.</p> <p>Open System Information > Graphics/Displays, and verify that the connected display appears in the list of displays recognized by the user's computer.</p> <p>Does a good image appear on the external display?</p>	Yes	Go to step 11.	`\${nodeText.yesSymptomCode}`	
		No	<p>The issue is isolated to the user's Thunderbolt cable.</p> <p>Replace the user's Thunderbolt cable.</p> <p>If user has third-party cable, refer to manufacturer for support.</p>	X03	EXTERNAL CABLE

	Check	Result	Action	Code	Commodity
11.	Connect the known-good display and HDMI cable to the user's USB-C Digital AV Multiport Adapter, then to one of the computer's USB-C ports.	Yes	The issue is isolated to the user's display. Inform the user of findings and refer to HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac for more information.	\${nodeText.yesSymptomCode}	
	Open System Information > Graphics/Displays, and verify that the connected display appears in the list of displays recognized by the user's computer. Does a good image appear on the external display?	No	The issue is isolated to the user's adapter. Replace the user's USB-C Digital AV Multiport Adapter or USB-C Digital AV VGA Adapter. If user has third-party adapter, refer to manufacturer for support.	X03	EXTERNAL CABLE
12.	Restart the computer and verify that a known-good external display works using both VGA and digital AV adapters.	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
	Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Is the issue resolved?	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	M99	

USB-C and Thunderbolt Connectivity Issues

Unlikely causes:

Antenna plate, bottom cover, fan, housing, memory, power supply, sleep indicator light, speaker.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Standard USB-C devices not recognized or not powered when connected to computer's USB-C port(s).USB 2 or USB 3 devices not recognized or not powered when connected to computer's USB-C port(s).External DisplayPort or Thunderbolt devices or displays not recognized when connected to computer's USB-C port(s). <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">Verify that any USB hubs connected to the computer have sufficient power for a connected USB device.Check whether the user's USB device requires a specific driver to function properly.If the user is using a USB 3 device, review HT201163: Using USB devices with your Mac.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do. Retest for USB-C connectivity issues.Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model.Using a Wi-Fi network, check for and apply the latest software and firmware updates. Also check for adapter firmware updates by leaving the user's adapter connected to the computer while running software update. If an update is available, update the adapter's firmware before proceeding further, and retest for USB-C connectivity issues.Refer to HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac to learn more about Thunderbolt connectivity in this computer.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Inspect all USB-C ports and rear I/O wall openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
	Important: Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.	No	Go to step 3.	\$(nodeText.noSymptomCode)	
	Is any USB-C port damaged?				

	Check	Result	Action	Code	Commodity
2.	<p>Inspect the opening on the rear I/O wall for the damaged USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB-C plug.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the rear I/O wall.</p> <p>Verify that the issue is resolved.</p>	X13	OTHER ELECTRIC
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
3.	<p>Using a known-good Apple USB-C to USB Adapter, connect a known-good high-speed USB (1.1/2.0) device, such as a mouse, keyboard, or USB 2 flash drive to the same USB-C port on the computer.</p> <p>Verify in System Information > USB that the device is detected.</p> <p>Is the USB 1.1/2.0 device detected?</p>	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
4.	<p>Disconnect and flip the orientation of the USB-C Apple adapter cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations.</p> <p>Refresh the USB Device Tree in System Information by using the Command-R keyboard shortcut, or the File > Refresh Information from the menu bar.</p> <p>Verify in System Information > USB that the device is detected.</p> <p>Is the USB 1.1/2.0 device detected?</p>	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
5.	Using a known-good Apple USB-C to USB Adapter, connect a known-good USB 3 device, such as a USB 3 hard drive or flash drive to the same USB-C port on the computer. Verify in System Information > USB that the device is detected. Is the USB 3 device detected?	Yes	Go to step 6.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
6.	Disconnect and flip the orientation of the USB-C Apple adapter cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations. Refresh the USB Device Tree in System Information by using the Command-R keyboard shortcut, or the File > Refresh Information from the menu bar. Verify in System Information > USB that the device is detected. Is the USB 3 device detected?	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
7.	Using the user's Apple USB-C to USB Adapter in place of the known-good adapter, connect a known-good USB 3 device, such as a USB 3 hard drive or flash drive to the same USB-C port on the computer. Refer to HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac for more information about Apple USB-C adapters. Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File > Refresh Information from the menu bar. Verify in System Information > USB that the device is detected. Be sure to test both orientations. Is the USB 3 device detected?	Yes	Go to step 8.	\$(nodeText.yesSymptomCode)	
		No	Replace the user's Apple USB-C adapter. If the adapter is made by a third party, advise the user to contact the manufacturer for support. Verify that the issue is resolved.	X03	EXTERNAL CABLE

	Check	Result	Action	Code	Commodity
8.	<p>Using a known-good Apple Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter, connect a known-good external Thunderbolt 2 device such as a display or external disk to the same USB-C port on the computer.</p> <p>Verify in System Information > Thunderbolt that the device is detected.</p> <p>Refer to HT207266: Connect devices and displays with the Apple Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter for more information about this adapter.</p> <p>Is the Thunderbolt 2 device detected?</p>	Yes	Go to step 9.	\$(nodeText.yesSymptomCode)	
		No	Go to step 13.	\$(nodeText.noSymptomCode)	
9.	<p>Disconnect and flip the orientation of the USB-C Apple adapter cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations.</p> <p>Refresh the USB Device Tree in System Information by using the Command-R keyboard shortcut, or the File > Refresh Information from the menu bar.</p> <p>Verify in System Information > Thunderbolt that the device is detected.</p> <p>Is the Thunderbolt 2 device detected?</p>	Yes	Go to step 10.	\$(nodeText.yesSymptomCode)	
		No	Go to step 13.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
10.	<p>Using the user's Apple Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter in place of the known-good adapter, connect a known-good external Thunderbolt 2 device such as a display or external disk to the same USB-C port on the computer.</p> <p>Refer to HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac for more information about Apple USB-C adapters.</p> <p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File > Refresh Information from the menu bar.</p> <p>Verify in System Information > Thunderbolt that the device is detected.</p> <p>Be sure to test both orientations.</p> <p>Is the Thunderbolt 2 device detected?</p>	Yes	Go to "No Video to External Display" troubleshooting flow.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the user's Apple USB-C adapter.</p> <p>If the adapter is made by a third party, advise the user to contact the manufacturer for support.</p> <p>Verify that the issue is resolved.</p>	X03	EXTERNAL CABLE
11.	<p>Determine if the following symptom was observed on the user's computer:</p> <p>USB device not detected.</p> <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M37	MLB
		No	Go to step 12.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
12.	<p>USB port has insufficient power.</p> <p>Determine if the following symptom was observed on the user's computer:</p> <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M38	MLB
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M15	MLB

	Check	Result	Action	Code	Commodity
13.	<p>Determine if the following symptom was observed on the user's computer:</p> <p>Thunderbolt display functionality issue.</p> <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M32	MLB
		No	Go to step 14.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
14.	Determine if the following symptom was observed on the user's computer: Thunderbolt not providing enough power.	Yes	Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M34	MLB
	Does this symptom accurately describe the user's issue?	No	Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M33	MLB
15.	Confirm that known-good USB high-speed and SuperSpeed devices and Thunderbolt 2 devices are functional and recognized when connected to all USB-C ports on the computer, in both orientations.	Yes	The issue is resolved. Verify resolution.	\$(nodeText.yesSymptomCode)	
	Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Is the issue resolved?	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

Flash Storage Not Recognized, Not Mounting, or Read/Write Issues

Unlikely causes:

Antenna plate, bottom cover, fan, housing, memory, power supply, rear I/O wall, sleep indicator light, speaker.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Starts up to a black screen with Apple logo.Displays a flashing folder with question mark or prohibitory symbol.Cannot save documents.Displays read/write error messages.Not responding when accessing or saving data. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>Important: Always ask if the user's data has been backed up before beginning the repair.</p> <ol style="list-style-type: none">Disconnect all peripherals and attempt to start up the computer.To restore the default startup disk, reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Use one of the following two methods to start up the computer to a known-good macOS.	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
	<p>Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.</p> <p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume.</p> <p>During startup, allow up to four minutes for a defective flash storage to time out, after which the computer will start up from a known-good external device.</p> <p>Does the computer start up from a known-good volume?</p>	No	Go to the "Will Not Start Up" troubleshooting flow.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
2.	<p>Run AST 2 Storage diagnostic test suite on the user's computer and examine the results of the test.</p> <p>Do all internal drive tests pass?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	<p>Examine AST 2 Storage diagnostic test suite results for presence of an internal drive.</p> <p>Does the computer pass or fail drive presence test?</p>	Pass	Go to step 4.	\$(nodeText.yesSymptomCode)	
		Fail	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M43	MLB
4.	<p>Examine diagnostic results for SMART status.</p> <p>Does the computer pass or fail SMART test?</p>	Pass	Go to step 5.	\$(nodeText.yesSymptomCode)	
		Fail	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M43	MLB

	Check	Result	Action	Code	Commodity
5.	Examine diagnostic results for Short Random Multi-Block Read Test. Does the computer pass or fail Short Random Multi-Block Read Test?	Pass	Go to step 6.	\${nodeText.yesSymptomCode}	
		Fail	Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M45	MLB
6.	Examine diagnostic results for File System Check. Does the computer pass or fail File System Check?	Pass	Go to step 7.	\${nodeText.yesSymptomCode}	
		Fail	Go to step 9.	\${nodeText.noSymptomCode}	
7.	Examine diagnostic results for Bootable Volume Presence Check. Does the computer pass or fail Bootable Volume Check?	Pass	Go to step 8.	\${nodeText.yesSymptomCode}	
		Fail	Go to step 9.	\${nodeText.noSymptomCode}	
8.	Examine diagnostic results for Last OS Reinstall Check. Does the computer pass or fail Last OS Reinstall Check?	Pass	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	M99	
		Fail	Go to step 9.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
9.	Use one of the following two methods to start up the computer to a known-good macOS.	Yes	Go to step 10.	\$(nodeText.yesSymptomCode)	
	<p>Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.</p> <p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume.</p> <p>Use Disk Utility to repair the user's internal flash storage volume.</p> <p>Attempt to start up the user's computer from its internal flash storage.</p> <p>Does the computer start up successfully from its internal flash storage?</p>	No	Go to step 11.	\$(nodeText.noSymptomCode)	
10.	<p>Run AST 2 Storage diagnostic test suite on the user's computer again and examine the results of the test.</p> <p>Does the computer pass all internal drive tests?</p>	Yes	The issue was resolved by repairing the flash storage volume. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

	Check	Result	Action	Code	Commodity
11.	Start up the computer to macOS Recovery or a known-good external macOS startup volume. Run Disk Utility and select the user's flash storage drive.	Yes	Go to step 10.	\$(nodeText.yesSymptomCode)	
	<p>Erase the flash storage drive using Mac OS Extended (Case-sensitive, Journaled) format and GUID Partition Map scheme.</p> <p>Erase the flash storage drive again using Mac OS Extended (Journaled) format and GUID Partition Map scheme.</p> <p>Formatting the drive twice with different partition map schemes will force a rewrite of the partitions table.</p> <p>Refer to HT204743: Partition a problematic drive two times before recommending service or replacement for more information.</p> <p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Does the computer start up successfully from its internal flash storage?</p>	No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M44	MLB
12.	Confirm that computer can successfully start up from internal flash storage.	Yes	The issue is resolved. Verify resolution.	\$(nodeText.yesSymptomCode)	
	<p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is issue resolved?</p>	No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

Burning Smell or Odor

Unlikely causes:

There are no unlikely causes for this issue.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Computer emits a burning, smoky, or other unusual odor. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">Disconnect all third-party devices to eliminate external devices as source of odor.Inspect the enclosure and components for obvious signs of burning or smoky residue. Check the rear vents, slots, ports, and power cord.Clean the enclosure to eliminate any causes due to external contamination.Verify that the vents allow unobstructed airflow into and out of the computer.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Determine whether this is a safety issue.	Yes	ESCALATION REQUIRED. Contact ACS for safety-related issues. Refer to article OP44: Handling Potential Product Safety Issues . Retail: Document the issue and escalate following the steps in RS60: Product Safety Escalations .	X99	
	Do not perform procedures that can be a safety risk to you or the user.				
	Have you identified a safety issue?	No	Go to step 2.	\${nodeText.noSymptomCode}	
2.	An odor can be related to external contamination. Inspect the computer exterior for contamination or lack of cleanliness.	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
	Can you determine that the odor is caused by external contamination?	No	Go to step 4.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
3.	<p>Thoroughly clean enclosure and all external surfaces. Refer to HT204172: Cleaning your Apple products. Explain the cause to the user.</p> <p>Does user agree that odor is due to external contamination?</p>	Yes	The issue is resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
4.	<p>Odors can be related to product newness. Refer to HT202324: Odors may be present short-term.</p> <p>Can you determine that the odor is due to the product being new?</p>	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 6.	`\${nodeText.noSymptomCode}`	
5.	<p>Explain to the user that new computers can sometimes emit an odor, similar to odors generated from new carpeting or a new car. In most cases, the odor dissipates after a brief period.</p> <p>Does the user agree that the odor is related to the computer being new?</p>	Yes	The issue is resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
6.	<p>Closely inspect internal components and the enclosure for indications of physical damage or contamination.</p> <p>Can you identify signs of internal damage or contamination?</p>	Yes	Go to the “Mechanical, Physical, or Cosmetic Damage” troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 7.	`\${nodeText.noSymptomCode}`	
7.	<p>Refer to TP1150: Visual/Mechanical Inspection (VMI) Guide for Mac Liquid Damage for guidance regarding possible liquid damage to the user’s computer.</p> <p>Does the computer exhibit this type of damage?</p>	Yes	Go to the “Mechanical, Physical, or Cosmetic Damage” troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
8.	<p>Closely inspect internal hardware and the enclosure for other possible causes of odor, such as bulging or vented chip capacitors, or visible residue or burn marks on the enclosure, logic board, or other components.</p> <p>Have you identified a component failure as the source of the odor?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	The issue cannot be duplicated.	\${nodeText.noSymptomCode}	
9.	<p>Run the computer for several hours and monitor for the issue/odor. Run the full system diagnostics available in AST 2. If no functional failure is detected, use correct positioning to explain to the user that the odor is related to external contamination or the newness of the computer.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Computer Runs Hot

Unlikely causes:

Antenna plate, bottom cover, housing, memory, rear I/O wall, sleep indicator light, speaker.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Computer feels unusually warm.• Fan is not operating.• Fan is not functioning at full capacity.• Fan runs constantly at high speeds. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Check for and apply the latest software and firmware updates.2. Mac mini has vents at the bottom to bring in cool air from beneath the device and vent hot air from the back. Verify the temperature issue with the computer resting on a hard, flat surface. Use this opportunity to educate the user about inappropriate work surfaces that may cause the computer to overheat.3. Ensure the fan spins during operation. Verify vents are not blocked. Blow out any dust or debris from rear fan exhaust with compressed air.4. Compare the computer's operating temperature to a known-good, similarly configured computer.5. Check for runaway applications using the information in HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity. Follow the instructions to halt any processes that are using excessive system resources.6. Processor-intensive or graphics-intensive applications and system processes may cause the bottom case to feel warm. Use Activity Monitor to identify these types of applications and explain the issue to the user.7. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the computer.	Yes	Go to step 2.	<code>\$(nodeText.yesSymptomCode)</code>	
	MRI will report a failure if any sensors are not detected or are exceeding expected thermal values.	No	Go to step 3.	<code>\$(nodeText.noSymptomCode)</code>	
	Does the computer pass all MRI tests?				

	Check	Result	Action	Code	Commodity
2.	Run AST 2 Cooling System Diagnostic (CSD) diagnostics suite. CSD works like a stress test on the computer, gathering information about the thermal performance while various components are under heavy use. Does the computer pass all CSD tests?	Yes	The computer passed all thermal checks and is operating within specifications. Verify correct operation and refer the customer to HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity .	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	A disconnected or nonfunctional fan will prevent proper cooling and cause thermal sensors to exceed expected values. Check diagnostic results for fan motor failures. Did diagnostics report any fan motor test failure?	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	Go to step 10.	\$(nodeText.noSymptomCode)	
4.	Disconnect the fan cable connector and inspect logic board and cable connector pins for damage. Check for a damaged connector or bent pins that prevent correct seating. Inspect the fan cable for cable damage. Did you find damage to the fan cable or any connector?	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Go to step 6.	\$(nodeText.noSymptomCode)	
5.	Determine whether the damage is located on the fan cable, the logic board, or both. Is the damage limited to the fan cable?	Yes	Replace the fan. Verify that the issue is resolved.	X03	OTHER ELECTRIC
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	P99	
6.	Carefully reseal the fan cable into its connector. Reassemble the computer and run diagnostics again. Do diagnostics still report a fan failure?	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
		No	Issue resolved by reseating fan cable. Verify resolution.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
7.	<p>Remove the fan to reveal inner side of heat sink. Use an ESD-safe vacuum to remove dust and debris from heat sink and fan.</p> <p>Reassemble the computer and run diagnostics again.</p> <p>Do diagnostics still report a fan failure?</p>	Yes	Go to step 8.	\$(nodeText.yesSymptomCode)	
		No	Issue resolved by cleaning fan and heat sink. Verify resolution.	\$(nodeText.noSymptomCode)	
8.	<p>Troubleshooting this issue completely requires a known-good fan.</p> <p>Do you have immediate access to a known-good fan?</p>	Yes	Go to step 9.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the fan.</p> <p>Verify that the issue is resolved.</p>	X22	OTHER ELECTRIC
9.	<p>Substitute a known-good fan.</p> <p>Reassemble the computer and run diagnostics again.</p> <p>Do diagnostics still report a fan failure?</p>	Yes	<p>Reinstall the user's fan.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M18	MLB
		No	<p>Replace the fan.</p> <p>Verify that the issue is resolved.</p>	X22	OTHER ELECTRIC
10.	<p>Check diagnostic results for failures related to any other thermal sensor errors.</p> <p>Did diagnostics report any thermal sensor errors?</p>	Yes	Go to step 11.	\$(nodeText.yesSymptomCode)	
		No	<p>The computer passed all thermal checks, and is operating within specifications.</p> <p>If the diagnostic is reporting other errors, select a different symptom based on the diagnostic results.</p>	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
11.	<p>Troubleshooting this issue completely requires a known-good power supply.</p> <p>Do you have immediate access to a known-good power supply?</p>	Yes	Go to step 12.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the power supply.</p> <p>Verify that the issue is resolved.</p>	P17	POWER SUPPLY
12.	<p>Substitute a known-good power supply.</p> <p>Reassemble the computer and run diagnostics again.</p> <p>Does the computer pass all tests?</p>	Yes	<p>Replace the power supply.</p> <p>Verify that the issue is resolved.</p>	P17	POWER SUPPLY
		No	<p>Reinstall the user's power supply.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M18	MLB
13.	<p>Use Cooling System Diagnostic to verify that the computer is running within thermal specifications.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Mechanical, Physical, or Cosmetic Damage

Unlikely causes:

There are no unlikely causes for this issue.

Quick Check

Symptoms	Quick Check
<p>The computer shows signs of physical and/or cosmetic damage such as:</p> <ul style="list-style-type: none">• Dented or scratched enclosure or bottom cover.• Screw is stripped, loose, or missing.• Broken or damaged internal or external components, cables, or connectors.• Liquid spill. <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Inspect the computer and discuss the nature of the issue with the user. Determine whether the user wants to proceed with the repair (despite possible accidental damage) or pursue other service options. Click “No” to proceed with further troubleshooting.2. Refer to TP1151: Visual/Mechanical Inspection (VMI) Guide for Mac Computers for guidance regarding possible damage to the user’s computer.3. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Determine the cause of damage or defects: <ul style="list-style-type: none"> • User • Technician • Environment • Accidental damage • Abuse 	Yes	ESCALATION REQUIRED. Contact ACS for assistance with Apple-related accidental damage.	X99	
	Is an Apple advisor responsible for the damage or defect on the computer?	No	Go to step 2.	\${nodeText.noSymptomCode}	
2.	Closely examine the user's computer for signs of enclosure or bottom cover damage such as: <ul style="list-style-type: none"> • Scratches • Dents • Cracks 	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP). Refer to www.apple.com/legal/warranty for details.	X13	ENCLOSURE
	Does the computer exhibit this type of damage?	No	Go to step 3.	\${nodeText.noSymptomCode}	
3.	Closely examine the user's computer enclosure and bottom cover for signs of liquid spill damage.	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).	X90	ENCLOSURE
	Look for any signs of liquid spill, liquid penetration, or liquid damage to the computer's enclosure.		Refer to www.apple.com/legal/warranty for details.		
	Does the computer exhibit this type of damage?	No	Go to step 4.	\${nodeText.noSymptomCode}	
4.	Closely examine the user's AC power cord for signs of mechanical damage.	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP). Refer to www.apple.com/legal/warranty for details.	X03	EXTERNAL CABLE
	Does the AC power cord exhibit any damage?	No	ESCALATION REQUIRED. Contact ACS for assistance with Apple-related accidental damage.	X99	

Noise, Hum, or Vibration

Unlikely causes:

Antenna plate, bottom cover, housing, memory, rear I/O wall, sleep indicator light, speaker.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Computer emits noise or vibration. <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>Note: Verify the issue after using the computer for a few minutes to warm it, or by following steps in HT207571: Warm a Mac for testing. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none">Work with user to reproduce issue and isolate source of noise.Verify vents on bottom and back of computer are free of dust and debris that might inhibit proper airflow through computer.If necessary, explain to user that some noises are normal. Refer to article HT202179: About fans and fan noise in your Apple product.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Shut down the computer and let it cool off fully. Once the computer is cold, start it up and check for noise, hum, or vibration. Does issue persist during cold startup?	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
2.	An unreadable thermal sensor can cause a fan to run excessively. Run AST 2 Mac Resource Inspector diagnostic suite (MRI) to check thermal sensors. Does MRI report any thermal sensor failures?	Yes	Go to “Computer Runs Hot” troubleshooting flow.	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	Excessive fan operation may also occur if computer is unable to read fan speed. Check MRI results for fan (motor) sensor test results. Does MRI report any fan (motor) failures?	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Go to step 4.	\$(nodeText.noSymptomCode)	
4.	Disconnect the fan and briefly retest for noise, hum, or vibration. Has noise been eliminated?	Yes	Replace the fan. Verify that the issue is resolved.	X23	OTHER ELECTRIC
		No	Go to step 11.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
5.	Disconnect the fan cable connector and inspect logic board and cable connector pins for damage. Check for a damaged connector or bent pins that prevent correct seating.	Yes	Go to step 6.	\${nodeText.yesSymptomCode}	
	Inspect the fan cable for cable damage.	No	Go to step 7.	\${nodeText.noSymptomCode}	
	Did you find damage to the fan cable or any connector?				
6.	Determine whether the damage is located on the fan cable, the logic board, or both. Is the damage limited to the fan cable?	Yes	Replace the fan. Verify that the issue is resolved.	X23	OTHER ELECTRIC
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	P99	
7.	Carefully reseal the fan cable into its connector.	Yes	Go to step 8.	\${nodeText.yesSymptomCode}	
	Reassemble the computer and run diagnostics again. Do diagnostics still report a fan failure?	No	Issue resolved by reseating fan cable. Verify resolution.	\${nodeText.noSymptomCode}	
8.	Remove the fan to reveal inner side of heat sink. Use an ESD-safe vacuum to remove dust and debris from heat sink and fan.	Yes	Go to step 9.	\${nodeText.yesSymptomCode}	
	Reassemble the computer and run diagnostics again. Do diagnostics still report a fan failure?	No	Issue resolved by cleaning fan and heat sink. Verify resolution.	\${nodeText.noSymptomCode}	
9.	Troubleshooting this issue completely requires a known-good fan.	Yes	Go to step 10.	\${nodeText.yesSymptomCode}	
	Do you have immediate access to a known-good fan?	No	Replace the fan. Verify that the issue is resolved.	X23	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
10.	Substitute a known-good fan. Reassemble the computer and run diagnostics again. Do diagnostics still report a fan failure?	Yes	Reinstall the user's fan. Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M18	MLB
		No	Replace the fan. Verify that the issue is resolved.	X23	OTHER ELECTRIC
11.	Connect computer to AC power and listen carefully, close to internal power supply. Is noise coming from power supply?	Yes	Replace the power supply. Verify that the issue is resolved.	P04	POWER SUPPLY
		No	Go to step 12.	\$(nodeText.noSymptomCode)	
12.	Disconnect any peripheral devices, cards, or cables attached to computer. Has noise been eliminated?	Yes	Issue resolved. Issue caused by ground loop induced by third-party devices. Advise user to connect all devices to a common power outlet or contact device manufacturer for support.	\$(nodeText.yesSymptomCode)	
		No	Go to step 13.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
13.	<p>Noise may be related to interference from other electrical devices operating near computer or plugged into same power outlet.</p> <p>See if noise is eliminated when computer runs in a different location on a different circuit.</p> <p>Has noise been eliminated?</p>	Yes	Issue resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
14.	<p>Verify that noise, hum, or vibration is resolved. There may be noise from fan and audio circuitry, but there should be no noise from the flash storage.</p> <p>If help is needed, record a sample audio file to review with ACS.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is issue resolved?</p>	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

Intermittent Shutdown

Unlikely causes:

Antenna plate, bottom cover, fan, housing, memory, rear I/O wall, sleep indicator light, speaker.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Shuts down during startupShuts down unexpectedly during use <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>Note: Verify the issue after using the computer for a few minutes to warm it, or by following steps in HT207571: Warm a Mac for testing. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none">Collect the following details from the user regarding shutdown occurrence and system configuration: when shutdown occurs (for example, after running for a while), the frequency of shutdowns, which applications are running at the time, and shutdown repeatability.Verify power cord is securely attached to back of power supply, and not getting caught (such as on a desk) and pulled loose.Verify power supply cable is securely attached to back of computer.Plug computer power supply directly into an AC outlet to isolate issues with a surge protector or UPS.Open System Preferences > Energy Saver > Schedule and make sure that a “Shut Down” event is not scheduled.Hold down the Shift key during startup to put the computer into safe mode. Refer to HT201262: Use safe mode to isolate issues with your Mac.Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.Reset the NVRAM using the procedure for this computer in article HT204063: Reset NVRAM or PRAM on your Mac.Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the computer.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	Power and thermal issues can cause intermittent shutdowns. MRI will report a failure if any sensors are not detected or are exceeding expected thermal values.	No	Go to step 4.	`\${nodeText.noSymptomCode}`	
	Does the computer pass all MRI tests?				

	Check	Result	Action	Code	Commodity
2.	Run AST 2 Cooling System Diagnostic (CSD) diagnostics suite.	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
	CSD works like a stress test on the computer, gathering information about the thermal performance while various components are under heavy use.	No	Go to step 4.	\${nodeText.noSymptomCode}	
3.	Does the computer pass all CSD tests?				
	Run Full System Diagnostic (both EFI and OS) and check whether the computer unexpectedly shuts down.	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
4.	Is the shutdown event reproducible?	No	Cannot duplicate issue.	\${nodeText.noSymptomCode}	
	Identify whether MRI reports a thermal or fan sensor failure, or a voltage or current sensor failure.	Thermal/Fan Sensor	Go to the "Computer Runs Hot" troubleshooting flow.	\${nodeText.yesSymptomCode}	
5.	There are three types of sensors that are used in the computer: voltage, current, and temperature. The sensor type is identified by the first letter in the sensor key.				
	<ul style="list-style-type: none"> Voltage sensor keys start with "V" Current sensor keys start with "I" Temperature sensor keys start with "T" 	Voltage/Current Sensor	Go to step 5.	\${nodeText.noSymptomCode}	
5.	Which sensor failure does MRI report?				
	Troubleshooting this issue completely requires a known-good power supply.	Yes	Go to step 6.	\${nodeText.yesSymptomCode}	
5.	Do you have immediate access to a known-good power supply?	No	Replace the power supply.	P02	POWER SUPPLY
			Verify that the issue is resolved.		

	Check	Result	Action	Code	Commodity
6.	Substitute a known-good power supply. Reassemble the computer and run diagnostics again. Does the computer pass all tests?	Yes	Replace the power supply. Verify that the issue is resolved.	P02	POWER SUPPLY
		No	Reinstall the user's power supply. Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M08	MLB
7.	Run Full System Diagnostic (both EFI and OS) to verify that the computer does not unexpectedly shut down. Is issue resolved?	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

Kernel Panic or System Instability

Unlikely causes:

Antenna plate, bottom cover, fan, housing, rear I/O wall, sleep indicator light, speaker.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Computer restarts and displays a kernel panic alert message. Refer to HT200553: If your Mac spontaneously restarts or displays a message that it restarted or shut down because of a problem.Computer freezes during use.Computer freezes upon wake from sleep.Computer freezes when Wi-Fi is turned on or activated. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>Note: Verify the issue after using the computer for a few minutes to warm it, or by following steps in HT207571: Warm a Mac for testing. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none">1. Disconnect any external peripherals.2. Verify memory configuration matches installed physical memory.3. Hold the Shift key down during startup to put the computer into safe mode. Refer to HT201262: Use safe mode to isolate issues with your Mac.4. Follow troubleshooting in HT200553: If your Mac spontaneously restarts or displays a message that it restarted or shut down because of a problem.5. Use macOS Recovery to troubleshoot potential software issues. Hold down Command-R during startup to restart from the recovery partition. See HT201314: About macOS Recovery.6. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates.7. If the issue cannot be easily reproduced, run the Full System Diagnostic suite via AST 2 for extended testing.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	A voltage, current, or thermal sensor error can cause kernel panics or system crashes. Run AST 2 Mac Resource Inspector diagnostic suite (MRI) or consult MRI logs to check for any sensor or fan failures.	Yes	Go to the “Intermittent Shutdown” troubleshooting flow.	\$(nodeText.yesSymptomCode)	
	Does MRI report any sensor or fan failures?	No	Go to step 2.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
2.	Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.	Yes	Issue resolved by resetting SMC and NVRAM. Verify resolution.	\$(nodeText.yesSymptomCode)	
	Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac . Does the computer start up and run without a kernel panic or freeze?	No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	Use one of the following two methods to start up the computer to a known-good macOS. Start up the computer to macOS Recovery. See HT201314: About macOS Recovery . Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume. Attempt to reproduce the issue. Does the computer start up and run without a kernel panic or freeze?	Yes	Go to step 6.	\$(nodeText.yesSymptomCode)	
		No	Go to step 4.	\$(nodeText.noSymptomCode)	
4.	Use AST 2 Memory diagnostic suite to verify installed memory. There are two SO-DIMM memory slots in this computer. SO-DIMMs are installed under a metal shield on the logic board. Does the memory fail testing?	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M06	MLB

	Check	Result	Action	Code	Commodity
5.	<p>Follow Service Guide procedures to open the computer and remove installed memory. Substitute one by one with a known-good memory module.</p> <p>Does the computer still experience crashes or kernel panics?</p>	Yes	<p>Reinstall the user's memory.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M06	MLB
		No	<p>Isolate and replace the defective memory module.</p> <p>Verify that the issue is resolved.</p>	X01	MEMORY
6.	<p>Run MRI and Storage Diagnostic via AST 2 to verify the functionality of the built-in flash storage.</p> <p>Check only for hardware errors reported by diagnostics, not software or file system errors.</p> <p>Are any hardware issues detected in the flash storage?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M06	MLB
		No	Go to step 7.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	

	Check	Result	Action	Code	Commodity
7.	<p>Use the results from AST 2 diagnostics to determine the macOS build version that is installed on the computer.</p> <p>Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model.</p> <p>Is the correct version of macOS installed on the user's drive?</p>	Yes	Go to step 8.	\$(nodeText.yesSymptomCode)	
		No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.noSymptomCode)	
8.	<p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.</p> <p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume.</p> <p>Use Disk Utility to repair the user's internal flash storage volume.</p> <p>Attempt to start up the user's computer from its internal flash storage.</p> <p>Does a kernel panic or crash still occur?</p>	Yes	Go to step 9.	\$(nodeText.yesSymptomCode)	
		No	The issue is resolved. Verify resolution.	\$(nodeText.noSymptomCode)	
9.	<p>Follow all steps in HT204743: Partition a problematic drive two times before recommending service or replacement.</p> <p>This will force a rewrite of the partition table.</p> <p>Reinstall macOS on the user's computer. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.</p> <p>Does a kernel panic or crash still occur?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M06	MLB
		No	The issue is resolved. Verify resolution.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
10.	Run full system diagnostics via AST 2 and verify that the system is stable with extended use, making sure the computer does not encounter a crash or kernel panic. Is the issue resolved?	Yes	The issue is resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

No Power

Unlikely causes:

Antenna plate, bottom cover, fan, housing, memory, sleep indicator light, speaker.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Computer does not power on• No image on external displays• No startup sound• No sounds from fan• No Caps Lock LED when key is pressed on wired keyboard <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. After logic board replacement, if the computer does not turn on, this could mean that the replacement logic board has not yet been configured for use. For complete instructions to configure a replacement logic board, refer to TP1657: System Configuration for Macs with the Apple T2 chip. Always complete all applicable procedures and diagnostic suites after part replacement, to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.2. Verify that you are using a functional power outlet and a known-good AC power cord.3. Disconnect all peripherals.4. Determine whether the computer has power by confirming that any of the following function correctly:<ul style="list-style-type: none">• Power indicator light illuminates• Startup sound• Fan spinning sound• Caps Lock key light turns on when pressed on wired keyboard• An external display functions5. Follow suggested steps in HT204267: If your Mac won't turn on.6. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Inspect user's power cord for wire or connector damage. Also inspect the computer's AC inlet port for signs of arcing or damaged pins that affect power cord connections. Did you find any damaged components?	Yes	Go to step 2.	<code>#{nodeText.yesSymptomCode}</code>	
		No	Go to step 4.	<code>#{nodeText.noSymptomCode}</code>	
2.	Determine if damage affects user's AC power cord or the computer's AC inlet port. Does damage only affect the power cord?	Yes	Replace the user's power cord. Verify that the issue is resolved.	X03	EXTERNAL CABLE
		No	Go to step 3.	<code>#{nodeText.noSymptomCode}</code>	

	Check	Result	Action	Code	Commodity
3.	<p>Determine if damage affects computer's AC inlet port or other parts.</p> <p>Does damage only affect AC inlet port?</p>	Yes	<p>Replace the power supply.</p> <p>Verify that the issue is resolved.</p>	P16	POWER SUPPLY
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
4.	<p>By reseating, verify the following:</p> <ul style="list-style-type: none"> User's power cord is securely plugged into a known-good, grounded electrical outlet that provides adequate voltage and power to operate computer. Power cord is fully seated to the computer's AC inlet port. <p>Attempt to turn on the computer.</p> <p>Does issue persist after reseating the power cord?</p>	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
		No	The issue was resolved by reseating the power cord.	\${nodeText.noSymptomCode}	
5.	<p>Substitute a known-good power cord and attempt to turn on the computer.</p> <p>Does the issue persist with a known-good power cord?</p>	Yes	Go to step 6.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the user's power cord.</p> <p>Verify that the issue is resolved.</p>	X03	EXTERNAL CABLE
6.	<p>Follow Service Guide procedures to open the computer and disconnect the power supply cable from the logic board.</p> <p>Inspect the power supply cable and connector, and its corresponding connector on the logic board for damage.</p> <p>Is damage found on the logic board or power supply cable or connectors?</p>	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	Go to step 8.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
7.	<p>Determine whether there is damage to the power supply cable or its connector, the logic board, or to a combination of multiple components.</p> <p>Is the damage limited to the power supply cable or its connector?</p>	Yes	<p>Replace the power supply.</p> <p>Verify that the issue is resolved.</p>	P16	POWER SUPPLY
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
8.	<p>Reseat the power supply cable to the logic board.</p> <p>Reassemble the computer. Reconnect the power cord and attempt to turn on the computer.</p> <p>Does the issue persist after reseating the power supply connector?</p>	Yes	Go to step 9.	\${nodeText.yesSymptomCode}	
		No	The issue was resolved by reseating the power supply connector to the logic board.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
9.	<p>Note: This step requires multimeter test probes with a very fine point in order to reach the conductive portion or the power button connector. The power button is part of the rear I/O wall. Do not replace the rear I/O wall unless you are using the correct multimeter probes when testing the power button.</p> <p>Follow Service Guide procedures to open the computer and disconnect the power button cable from the logic board.</p> <p>Inspect the cable and connector for damage. Using a multimeter set as ohm meter, verify continuity between the two pins of the power button when it is pressed.</p> <p>A properly working power button should be open (disconnected) when the button is released and closed (connected) when the button is pressed.</p> <p>A meter reading of 0 to 0.2 Ω (ohms) means that the power button has continuity (the button is closed or connected).</p> <p>A meter reading of 0.2 Ω (ohms) to ∞ (infinity) means that the power button does not have continuity (the button is open or disconnected).</p> <p>For additional information on using a multimeter, see HT3250: Using a digital multimeter.</p> <p>Does power button have continuity when button is pressed and open when released?</p>	Yes	Go to step 10.	<code>\${nodeText.yesSymptomCode}</code>	
		No	<p>Replace the rear I/O wall.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
10.	<p>Remove the coin battery from the logic board.</p> <p>Measure the logic board coin battery voltage.</p> <p>Carefully touch one multimeter probe to each pad to measure an expected coin battery voltage of 3 volts DC.</p> <p>If the voltage is 2.7 VDC or less, replace the coin battery.</p> <p>For additional information on using a multimeter, see HT3250: Using a digital multimeter.</p> <p>Is the coin battery voltage low (2.7 VDC or less)?</p>	Yes	<p>Replace coin cell battery.</p> <p>Note: Effective immediately, some coin cell batteries used on Mac systems are now available only from electronics parts distributors (for example, MCM). The coin battery is no longer available to order via GSX. Please order this battery from an electronics parts distributor.</p> <p>Note: BR2032 and CR2032 batteries have the same form factor and nominal voltage. However, BR2032 batteries have a lower self-discharge rate and broader operating temperature range than CR2032 batteries for longer shelf and service life.</p> <p>Verify that the issue is resolved.</p>	X32	OTHER ELECTRIC
		No	Go to step 11.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
11.	Reinstall and reseal the coin battery on the logic board. Reassemble the computer. Reconnect the power cord and attempt to turn on the computer. Does the computer show any signs of power activity?	Yes	Replace coin cell battery. Note: Effective immediately, some coin cell batteries used on Mac systems are now available only from electronics parts distributors (for example, MCM). The coin battery is no longer available to order via GSX. Please order this battery from an electronics parts distributor. Note: BR2032 and CR2032 batteries have the same form factor and nominal voltage. However, BR2032 batteries have a lower self-discharge rate and broader operating temperature range than CR2032 batteries for longer shelf and service life. Verify that the issue is resolved.	X32	OTHER ELECTRIC
		No	Go to step 12.	#{nodeText.noSymptomCode}	
12.	Troubleshooting this issue completely requires a known-good power supply. Do you have immediate access to a known-good power supply?	Yes	Go to step 13.	#{nodeText.yesSymptomCode}	
		No	Replace the power supply. Verify that the issue is resolved.	P01	POWER SUPPLY

	Check	Result	Action	Code	Commodity
13.	Substitute a known-good power supply. Reassemble the computer, reconnect the power cord, and attempt to turn on the computer. Does the issue persist with a known-good power supply?	Yes	Reinstall the user's power supply. Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M01	MLB
		No	Replace the power supply. Verify that the issue is resolved.	P01	POWER SUPPLY
14.	Verify that the computer can now complete the startup process over multiple trials. Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Is the issue resolved?	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

Will Not Start Up

Unlikely causes:

Antenna plate, bottom cover, fan, housing, power supply, rear I/O wall, sleep indicator light, speaker.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> • Computer turns on but does not complete startup sequence • Some video activity, Apple logo, progress bar • Prohibitory sign or folder with flashing question mark • Error beep tones • Audible fan sounds • Caps Lock LED on wired keyboard toggles on and off when pressed <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"> 1. In the event that there is an iBridge/macOS version mismatch in the user's computer, iBridge firmware will update automatically while the computer is connected to the Internet. During this process, the computer's display can remain completely black for at least 30 seconds. If the computer is turned off or disconnected from the Internet during this process under the assumption that something went wrong, the black screen will occur again until the iBridge update has completed. To resolve this issue, plug in the computer, attempt to turn it on, then wait at least one minute to provide an opportunity for any updates to complete if needed. Once completed, the computer should display video once again. 2. After logic board replacement, if the computer turns on but displays only a black screen and does not start up, this could mean that the replacement logic board has not yet been configured for use. For complete instructions to configure a replacement logic board, refer to TP1657: System Configuration for Macs with the Apple T2 chip. Always complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. 3. Use macOS Recovery to troubleshoot potential software issues. Press and hold Command-R during startup to restart from the recovery partition. See HT201314: About macOS Recovery. 4. Refer to HT201260: How to find the macOS version number on your Mac to make sure system build is correct for this computer model. Check for and apply the latest software and firmware updates. Remember that third-party software can contribute to this issue. It may be necessary to check for and apply third-party updates that may not appear in the App Store. 5. Verify that startup process passes initial memory checks and POST (Power-On Self-Test) with some video activity. If computer generates beeping sounds, there may be an issue with memory. See HT201702: About Mac Power On Self Test (POST) RAM error codes. 6. Try to determine what the computer was doing during startup. Refer to HT204156: About the screens you see when your Mac starts up. 7. Follow suggested steps in HT206182: Helping customers with a Mac that doesn't start up. 8. Follow suggested steps in HT204463: Fans run at full speed after computer turns on. 9. Hold down the Shift key during startup to put the computer into safe mode. Refer to HT201262: Use safe mode to isolate issues with your Mac. 10. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do. 11. Reset the NVRAM using the procedure for this computer in HT204063: How to Reset NVRAM or PRAM on your Mac. 12. Start up from Mac Resource Inspector diagnostic suite (MRI), check for the presence of an installed macOS, then refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model.

	Check	Result	Action	Code	Commodity
1.	Connect the user's power cord to the user's computer, and to a known-good, grounded electrical outlet that provides adequate voltage and power to operate computer. Verify that the power cord is fully seated to the computer's AC inlet port.	Yes	Go to step 2.	\${nodeText.yesSymptomCode}	
	<p>Connect a known-good display, wired keyboard, and mouse to the user's computer.</p> <p>Attempt to turn on the computer.</p> <p>Check for any signs of power by confirming that any of the following function correctly:</p> <ul style="list-style-type: none"> • Startup sound • Fan spinning sound • Caps Lock key light turns on when pressed on wired keyboard • An external display functions <p>Does computer show any sign of power activity?</p>	No	Go to the "No Power" troubleshooting flow.	\${nodeText.noSymptomCode}	
2.	Reset the NVRAM using the procedure for this computer in HT204063: How to Reset NVRAM or PRAM on your Mac .	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
	<p>Check for any signs that the computer is starting up.</p> <p>Can you confirm that the computer is starting up?</p>	No	Go to step 3.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
3.	Follow Service Guide procedures to open the computer and remove installed memory.	Yes	Isolate and replace the defective memory module.	X02	MEMORY
	There are two SO-DIMM memory slots in this computer. SO-DIMMs are installed under a metal shield on the logic board.		Verify that the issue is resolved.		
3.	Substitute one by one with a known-good memory module.	No	Reinstall the user's memory.	M02	MLB
	Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do		Replace the logic board.		
3.	Reset the NVRAM using the procedure for this computer in HT204063: How to Reset NVRAM or PRAM on your Mac .	No	Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.	M02	MLB
	Connect a known-good display, wired keyboard, and mouse to the user's computer.		Verify that the issue is resolved.		
4.	Attempt to turn on the computer.	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
	Check for any signs that the computer is starting up.		Go to "No Video to External Display" troubleshooting flow.		
5.	Can you confirm that the computer is starting up?	Yes	Go to the "Kernel Panic or System Instability" troubleshooting flow.	\${nodeText.yesSymptomCode}	
	Press and hold the Option or Alt key to start up the computer. Observe the startup process to verify that the computer starts up to Startup Manager.		Go to step 6.		
5.	The startup will show, at a minimum, a black screen with a mouse cursor.	No	Go to the "Kernel Panic or System Instability" troubleshooting flow.	\${nodeText.noSymptomCode}	
	Does the computer start up to Startup Manager?		Go to step 6.		
5.	Start up the computer and determine whether a kernel panic is occurring.	Yes	Go to the "Kernel Panic or System Instability" troubleshooting flow.	\${nodeText.yesSymptomCode}	
	Refer to HT200553: If your Mac spontaneously restarts or displays a message that it restarted or shut down because of a problem .		Go to step 6.		
5.	Does the computer display a kernel panic during startup?	No	Go to the "Kernel Panic or System Instability" troubleshooting flow.	\${nodeText.noSymptomCode}	
	Does the computer display a kernel panic during startup?		Go to step 6.		

	Check	Result	Action	Code	Commodity
6.	Use one of the following two methods to start up the computer to a known-good macOS.	Yes	Go to step 9.	\${nodeText.yesSymptomCode}	
	<p>Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.</p> <p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume.</p> <p>During startup, allow up to four minutes for a defective flash storage to time out, after which the computer will start up from a known-good external device.</p> <p>Does the computer start up from a known-good volume?</p>	No	Go to step 7.	\${nodeText.noSymptomCode}	
7.	<p>Follow Service Guide procedures to open the computer.</p> <p>Inspect all internal cables and connectors for damage.</p> <p>Are any internal cables or connectors damaged?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	Go to step 8.	\${nodeText.noSymptomCode}	
8.	<p>Reseat the internal connections and reassemble the computer.</p> <p>Attempt a normal startup.</p> <p>Does the computer start up?</p>	Yes	The issue was resolved by reseating the internal connections. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M02	MLB

	Check	Result	Action	Code	Commodity
9.	<p>Run AST 2 MRI and Storage Diagnostic suites to verify the functionality of the built-in flash storage.</p> <p>Check only for hardware errors reported by diagnostics. Do not check for software or file system errors.</p> <p>Are any hardware issues detected in the flash storage?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M43	MLB
		No	Go to step 10.	\$(nodeText.noSymptomCode)	
10.	<p>Use the results from AST 2 diagnostics to determine the macOS build version that is installed on the computer.</p> <p>Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model.</p> <p>Is the correct version of macOS installed on the user's drive?</p>	Yes	Go to step 11.	\$(nodeText.yesSymptomCode)	
		No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.noSymptomCode)	
11.	<p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.</p> <p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume.</p> <p>Use Disk Utility to repair the user's internal flash storage volume.</p> <p>Attempt to start up the user's computer from its internal flash storage.</p> <p>Does the computer start up successfully from its internal flash storage?</p>	Yes	The issue is resolved. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	Go to step 12.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
12.	<p>Follow all steps in HT204743: Partition a problematic drive two times before recommending service or replacement.</p> <p>This will force a rewrite of the partition table.</p> <p>Reinstall macOS on the user's computer. Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.</p> <p>Does the computer start up successfully from its internal flash storage?</p>	Yes	The issue is resolved. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M44	MLB
13.	<p>Verify that the computer can now complete the startup process over multiple trials.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

About Apple service certifications

Topic

To learn more about accessing [ATLAS](#) and service exams, review these articles:

- [How to get a Tech ID](#)
- [ATLAS frequently asked questions](#)
- [How to access Apple service exams at Pearson VUE](#)
- Certifications Explained Video - ([SV370](#)) for AASPs, ([SV371](#)) for Apple Store employees.

Note: Apple Store employees must read [Understanding Exam and Certification requirements](#) (RS228), in addition to this procedure.

Exams and courses that you need to service iOS products

Training for Apple Certified iOS Technician (ACiT) 2018 is available to technicians who work at Apple-authorized service facilities. Technicians need a Global Service Exchange (GSX) account to see the courses in [ATLAS](#).

To register for any ACiT exam, use [Pearson VUE](#).

ACiT 2018 certification

With ACiT 2018 certification, you can service iOS devices such as iPhone and iPad after passing the following exams:

- Apple Service Fundamentals Exam (SVC-18A) or (SVC-17A)
- ACiT 2018 iOS Service Certification Exam (iOS-18A)

Please note that the following devices have additional requirements:

- iPad Pro 12.9-inch (3rd generation), iPad Pro 11.0-inch
 - Also complete the Troubleshooting iPad course ([PQ-054](#)) in ATLAS.
- iPhone XS and iPhone XS Max:
 - Also complete the iPhone XS and iPhone XS Max Product Qualification ([PQ-045](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS.
- iPhone XR:
 - Also complete the iPhone XR Product Qualification ([PQ-046](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS.

ACiT 2017 certification

Important: If you are not already ACiT 2017 certified, complete the ACiT 2018 exam instead.

With ACiT 2017 certification, you can service iPhone, iPad, Apple Watch and Apple TV devices after passing the following exams:

- Apple Service Fundamentals Exam (SVC-17A)
- ACiT 2017 iOS Service Certification Exam (iOS-17A)

Please note that the following devices have additional product qualification requirements:

- iPad Pro 12.9-inch (3rd generation), iPad Pro 12.9-inch (2nd Generation), iPad Pro 12.9-inch, iPad Pro 11.0-inch, iPad Pro 10.5-inch, iPad Pro 9.7-inch, iPad (6th Generation), iPad (5th Generation) and iPad mini 4
 - Also complete the Troubleshooting iPad course ([PQ-054](#)) in ATLAS.
- iPhone 8 and iPhone 8 Plus
 - Also complete the Servicing iPhone 8 and 8 Plus course ([PQ-036](#)) in ATLAS.
- iPhone X
 - Also complete the Servicing iPhone X course ([PQ-040](#)) in ATLAS
- iPhone XS and iPhone XS Max
 - Also complete the iPhone XS and iPhone XS Max Product Qualification ([PQ-045](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS.
- iPhone XR:
 - Also complete the iPhone XR Product Qualification ([PQ-046](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS.

ACiT 2016 certification

With ACiT 2016 certification, you can service iPhone, iPad, Apple Watch and Apple TV devices after passing these exams:

- Apple Service Fundamentals Exam (SVC-16A)
- ACiT 2016 iOS Service Certification Exam (iOS-16A)

Please note that the following devices have additional product qualification requirements:

- iPad Pro 12.9-inch (3rd generation), iPad Pro 12.9-inch (2nd Generation), iPad Pro 12.9-inch, iPad Pro 11.0-inch, iPad Pro 10.5-inch, iPad Pro 9.7-inch, iPad (6th Generation), iPad (5th Generation) and iPad mini 4
 - Also complete the Troubleshooting iPad course ([PQ-054](#)) in ATLAS.
- iPhone 7, iPhone 7 Plus
 - Also complete the Servicing iPhone 7 and iPhone 7 Plus course ([9L0-PQ20](#)) in ATLAS.
- iPhone 8 and iPhone 8 Plus
 - Also complete the Servicing iPhone 8 and 8 Plus course ([PQ-036](#)) in ATLAS.
- iPhone X
 - Also complete the Servicing iPhone X course ([PQ-040](#)) in ATLAS
- iPhone XS and iPhone XS Max
 - Also complete the iPhone XS and iPhone XS Max Product Qualification ([PQ-045](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS.
- iPhone XR:
 - Also complete the iPhone XR Product Qualification ([PQ-046](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS.

Exams and courses that you need to service Mac products

Training for Apple Certified Mac Technician (ACMT) 2018 is available to technicians who work at Apple-authorized service facilities. Technicians need a Global Service Exchange (GSX) account to view the courses in [ATLAS](#). To register for any ACMT exam, use [Pearson VUE](#).

ACMT 2018 certification

With ACMT 2018 certification, you can service Mac computers after passing these exams:

- Apple Service Fundamentals Exam (SVC-18A) or (SVC-17A)
- ACMT 2018 Mac Service Certification Exam (MAC-18A)

These computers have additional product qualification requirements:

- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2018) Product Qualification course ([PQ-044](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Air (Retina, 13-inch, 2018):
 - Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product qualification course ([PQ-050](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.

ACMT 2017 certification

Important: If you're not already ACMT 2017 certified, complete the ACMT 2018 exams instead.

With ACMT 2017 certification, you can service most Mac computers after passing these exams:

- Apple Service Fundamentals Exam (SVC-17A)
- ACMT 2017 Mac Service Certification Exam (MAC-17A)

These computers have additional product qualification requirements:

- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2018) Product Qualification course ([PQ-044](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in

ATLAS.

- MacBook Pro (15-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Two Thunderbolt 3 Ports ([9L0-PQ23](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook (Retina, 12-inch, 2017):
 - Also complete the MacBook (Retina, 12-inch, 2017) ([9L0-PQ32](#)), Trackpad Calibration Check ([9L0-PQ15](#)) and Interpreting Liquid Contact Indicators (LCIs) ([9L0-PQ30](#)) courses in ATLAS
- MacBook Air (Retina, 13-inch, 2018):
 - Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Air (11-inch, Mid 2013, Early 2014, and Early 2015) and MacBook Air (13-inch, Mid 2013, Early 2014, and 2017):
 - Also complete the MacBook Air course ([9L0-PQ31](#)) in ATLAS.
- iMac Pro (2017):
 - Also complete the Servicing iMac Pro (2017) ([PQ-041](#)) course in ATLAS
- iMac (2017):
 - Also complete the iMac (2017) ([9L0-PQ28](#)) course in ATLAS
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product qualification course ([PQ-050](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.

ACMT 2016 certification

If you're not already ACMT 2016 certified, complete the ACMT 2018 exams instead.

With ACMT 2016 certification, you can service most Mac computers (some have additional requirements) after passing these exams:

- Apple Service Fundamentals Exam (SVC-16A)
- ACMT 2016 Mac Service Certification Exam (MAC-16A)

These computers have additional requirements:

- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2018) Product Qualification course ([PQ-044](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (15-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Two Thunderbolt 3 Ports ([9L0-PQ23](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook (Retina, 12-inch, 2017):
 - Also complete the MacBook (Retina, 12-inch, 2017) ([9L0-PQ32](#)), Trackpad Calibration Check ([9L0-PQ15](#)) and Interpreting Liquid Contact Indicators (LCIs) ([9L0-PQ30](#)) courses in ATLAS
- MacBook (Retina, 12-inch, Early 2016):
 - Also complete the MacBook (Retina, 12-inch, Early 2016) ([9L0-PQ18](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook Air (Retina, 13-inch, 2018):

- Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Air (11-inch, Mid 2013, Early 2014, and Early 2015) and MacBook Air (13-inch, Mid 2013, Early 2014, and 2017):
 - Also complete the MacBook Air course ([9L0-PQ31](#)) in ATLAS.
- iMac Pro (2017):
 - Also complete the Servicing iMac Pro (2017) ([PQ-041](#)) course in ATLAS
- iMac (2017):
 - Also complete the iMac (2017) ([9L0-PQ28](#)) course in ATLAS
- iMac (2015):
 - Also complete the iMac (Late 2015) ([9L0-PQ17](#)) course in ATLAS.
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product qualification course ([PQ-050](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.

ACMT 2015 certification

If you're not already ACMT 2015 certified, complete the ACMT 2018 exams and courses instead.

With ACMT 2015 certification, you can service many Mac computers (some have additional requirements) if you passed these exams:

- OS X Yosemite Troubleshooting Exam (9L0-066)
- Mac Hardware Service Exam (9L0-012)

These computers have additional requirements:

- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2018) Product Qualification course ([PQ-044](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (15-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (Retina, 15-inch, Mid 2015):
 - Also complete the MacBook Pro 15-inch (2012 to 2015) ([9L0-PQ34](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Two Thunderbolt 3 Ports ([9L0-PQ23](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (Retina, 13-inch, Early 2015):
 - Also complete the MacBook Pro 13-inch (2012 to 2015) course ([9L0-PQ33](#)) in ATLAS.
- MacBook (Retina, 12-inch, 2017):
 - Also complete the MacBook (Retina, 12-inch, 2017) ([9L0-PQ32](#)), Trackpad Calibration Check ([9L0-PQ15](#)) and Interpreting Liquid Contact Indicators (LCIs) ([9L0-PQ30](#)) courses in ATLAS
- MacBook (Retina, 12-inch, Early 2016):
 - Also complete the MacBook (Retina, 12-inch, Early 2016) ([9L0-PQ18](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook (Retina, 12-inch, Early 2015):
 - Also complete the MacBook (Retina, 12-inch, Early 2015) ([9L0-PQ14](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook Air (Retina, 13-inch, 2018):
 - Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Air (11-inch, Mid 2013, Early 2014, and Early 2015) and MacBook Air (13-inch, Mid 2013, Early 2014, and 2017):
 - Also complete the MacBook Air course ([9L0-PQ31](#)) in ATLAS.
- iMac Pro (2017):
 - Also complete the Servicing iMac Pro (2017) ([PQ-041](#)) course in ATLAS
- iMac (2017):

- Also complete the iMac (2017) ([9L0-PQ28](#)) course in ATLAS
- iMac (2015):
 - Also complete the iMac (Late 2015) ([9L0-PQ17](#)) course in ATLAS.
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product qualification course ([PQ-050](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.

ACMT certification

If you're not already ACMT certified, complete the ACMT 2018 exams and courses instead.

With ACMT certification, you can service certain Mac computers (some have additional requirements) after passing these exams:

- Mac OS X Mavericks Troubleshooting Exam (9L0-065)
- Mac Hardware Service Exam (9L0-011)

These computers have additional requirements. (Some of these exams and courses are not currently available.)

- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2018) Product Qualification course ([PQ-044](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (15-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (Retina, Mid 2012) and MacBook Pro (Retina, 15-inch, Early 2013 to Mid 2014):
 - Also complete the MacBook Pro 15-inch (2012 to 2015) ([9L0-PQ34](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (13-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Two Thunderbolt 3 Ports ([9L0-PQ23](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (Retina, 13-inch, Late 2012 to Early 2015):
 - Also complete the MacBook Pro 13-inch (2012 to 2015) course ([9L0-PQ33](#)) in ATLAS.
- MacBook (Retina, 12-inch, 2017):
 - Also complete the MacBook (Retina, 12-inch, 2017) ([9L0-PQ32](#)), Trackpad Calibration Check ([9L0-PQ15](#)) and Interpreting Liquid Contact Indicators (LCIs) ([9L0-PQ30](#)) courses in ATLAS
- MacBook (Retina, 12-inch, Early 2016):
 - Also complete the MacBook (Retina, 12-inch, Early 2016) ([9L0-PQ18](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook (Retina, 12-inch, Early 2015):
 - Also complete the MacBook (Retina, 12-inch, Early 2015) ([9L0-PQ14](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook Air (Retina, 13-inch, 2018):
 - Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Air (11-inch, Mid 2013, Early 2014, and Early 2015) and MacBook Air (13-inch, Mid 2013, Early 2014, and 2017):
 - Also complete the MacBook Air course ([9L0-PQ31](#)) in ATLAS.
- iMac Pro (2017):
 - Also complete the Servicing iMac Pro (2017) ([PQ-041](#)) course in ATLAS
- iMac (2017):
 - Also complete the iMac (2017) ([9L0-PQ28](#)) course in ATLAS
- iMac (2015):
 - Also complete the iMac (Late 2015) ([9L0-PQ17](#)) course in ATLAS.
- iMac (Late 2012 to Mid 2015 models):
 - Also complete the iMac (2012 to 2015) course ([9L0-PQ3](#)) in ATLAS.
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product Qualification course ([PQ-050](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.

About the Apple Service Fundamentals Exam (SVC-18A)

The Apple Service Fundamentals Exam (SVC-18A) is a computer-based knowledge test that Pearson VUE offers online. The test is open resource and test takers should use Apple references and courses in ATLAS to help answer the exam items.

Successful completion of this exam fulfills the prerequisite for Apple Certified iOS Technician (ACiT) 2018 certification and Apple Certified Mac Technician (ACMT) 2018 certification. The SVC-18A exam must be successfully completed before taking the Mac or iOS certification exams.

Exam summary

- Number of sections: 5
- Number of learning objectives: 34
- Number of total items: 70
- Passing score: 80 percent overall (at least 56 out of 70 items to pass)
- Exam time limit: 2 hours

Seven demographic questions are presented at the beginning of the exam. These items aren't scored and don't use the 2 hours given for the exam.

Two separately scored sections must be passed

The exam has two separately-scored sections that each must be passed to pass the entire exam. This is in addition to the overall passing score listed above. The two sections are listed below:

- The ESD Precautions section (at least 10 out of 12 questions answered correctly to pass)
- The Safety section (at least 10 out of 12 questions answered correctly to pass)

Sections and topics

Here are the sections and topics covered in Apple Service Fundamentals Exam:

Customer Experience (23 items)

- Identify the probing skills that result in getting good information from the customer
- Select good examples of reflecting and summarizing the customer's answers in order to come to agreement on the issue
- Identify ways to properly position a repair so that the customer knows why it is necessary and is in agreement with the strategy
- Identify ways to position and recommend upgrades and attachments as part of an alternative service strategy.
- Demonstrate use of the "Positive No" in a series of choose-the-phrase exercises
- List practical applications of the four cornerstones of adult learning
- Describe the effect of both complex technical language and over-simplified language
- Identify good examples of phrases to help set accurate customer expectations
- Describe the role of empathy in customer satisfaction
- Identify ways to avoid conflict by using genuine empathy
- Identify causes for conflict in an interaction
- Identify the five-step anger diffusion technique given a customer scenario
- Assess and explain the impact of non-verbal communication

ESD Precautions (12 items)

- Correctly identify and practice ESD precautions
- Correctly identify the components of an ESD-compliant workstation
- Use the proper tools, equipment, and procedures to configure a workspace that minimizes or eliminates the occurrence of electrostatic discharge damage
- Correctly identify the effects of ESD damage on an integrated circuit
- Correctly identify common ESD myths and why they are not true

Safety (12 items)

- Identify those customer statements that will generate a Safety First issue
- Explain the importance of exercising special care when handling lithium-ion/polymer batteries
- Demonstrate the proper and safe handling of batteries
- Recognize and identify signs and symptoms of damaged batteries
- Respond to events involving embedded batteries

Troubleshooting (8 items)

- Identify the different stages of troubleshooting and service where diagnostic tools are useful
- List the components of clear, concise and complete case notes
- Demonstrate basic troubleshooting and deductive reasoning skills
- Use smart questioning techniques and first-level evaluation and isolation skills to identify issues as being generally hardware based, software based, educational, or environmental in nature

Product Knowledge (15 items)

- List and understand basic iOS controls and navigation
- Identify the components of the default macOS user environment
- List Apple Watch controls and Navigation
- Given a customer scenario, evaluate, isolate, and resolve an Apple ID related issue
- List the steps to configure Continuity services in macOS and in iOS
- Describe how to configure a Bluetooth device in an Apple product
- Identify the methods for backing up and restoring data on an Apple product

Courses in ATLAS

To prepare for the Apple Service Fundamentals Exam, we suggest that you review the courses in the 2018 Service Fundamentals subject area in ATLAS. The list of courses in the suggested order can be found in [2018 Service Fundamentals](#).

About the ACiT 2018 iOS Service Certification Exam (iOS-18A)

The ACiT 2018 iOS Service Certification Exam is a computer-based knowledge test that Pearson VUE offers online. This is an open-resource test. We encourage you to use Apple references and courses in ATLAS to answer the questions.

To earn Apple Certified iOS Technician (ACiT) 2018 certification, you need to pass this exam (iOS-18A) and the Apple Service Fundamentals Exam (SVC-18A).

Please note: The Apple Service Fundamentals Exam must be taken before you take the iOS Service Certification Exam.

Exam summary

- Number of sections: 2
- Number of learning objectives: 18
- Number of total items: 70
- Passing score: 80 percent overall (at least 56 out of 70 items to pass)
- Exam time limit: 2 hours

Seven demographic questions are presented at the beginning of the exam. These items aren't scored and don't use the 2 hours given for the exam.

Sections and topics

Here are the sections and topics covered in ACiT Exam:

Troubleshooting (38 items)

- Describe the diagnostics used in troubleshooting a given scenario
- Given an isolated issue, categorize the issue as either hardware (including accidental damage), software, environmental, or educational opportunity
- Order the steps in the iOS setup and activation process
- List common resolutions for battery-related issues
- Identify basic controls for mailbox management
- Describe the built-in apps and features of iOS
- Describe how to personalize and customize iPhone General and Accessibility settings
- Describe the privacy settings that can be put in place for apps

Servicing iPhone (32 items)

- Identify the physical supplies and online resources necessary to ensure proper and safe servicing of an iPhone model
- Given a simulated workstation, identify the supplies that are necessary to reduce the possibility of being harmed while servicing iPhone
- Identify the tools that are commonly used to service all iOS models
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 5s
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 5c

- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 6 and iPhone 6 Plus
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 6s and iPhone 6s Plus
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone SE
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 7 and iPhone 7 Plus
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 8 and 8 Plus
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone X

Courses in ATLAS

To prepare for the ACiT 2018 iOS Service Certification Exam (iOS-18A), we suggest that you review the courses in the ACiT 2018 subject area in ATLAS. The list of courses in the suggested order can be found in [ACiT 2018 Overview](#).

About the ACMT 2018 Mac Service Certification Exam (MAC-18A)

The ACMT 2018 Mac Service Certification Exam (MAC-18A) is a computer-based knowledge test that Pearson VUE offers online. This is an open-resource test. We encourage you to use Apple references and courses in ATLAS to answer the questions.

To earn Apple Certified Mac Technician (ACMT) 2018 certification, you need to pass this exam (MAC-18A) and the Apple Service Fundamentals Exam (SVC-18A).

Please note: You must complete the Apple Service Fundamentals Exam before you take the Mac Service Certification Exam.

Exam summary

- Number of sections: 2
- Number of learning objectives: 28
- Number of total items: 70
- Passing score: 80 percent overall (at least 56 out of 70 items to pass)
- Exam time limit: 2 hours

Seven demographic questions are presented at the beginning of the exam. These items aren't scored and don't use the 2 hours given for the exam.

Sections and topics

Here are the sections and topics covered in ACMT Exam:

Troubleshooting (36 items)

- Evaluate and isolate file system issues with macOS-based systems
- Given a network related customer issue, accurately evaluate, isolate and resolve the issue
- Correctly identify the diagnostic tool most appropriate to a given troubleshooting scenario
- Describe how to use troubleshooting tools and related procedures
- Identify potential startup issues and associated fixes
- Identify macOS migration tools needed for migration, the types of user data that can be migrated, and the correct methods for migrating user data from both a Mac and PC
- Identify the symptoms that are a result of an SMC that is not functioning correctly
- Explain how to maximize the battery life of an Apple product
- Identify the process to create, configure, manage, and delete user accounts in macOS
- Configure FileVault 2 in macOS to secure the data on a Mac
- Describe the data privacy concerns that are presented when Location Services is enabled in macOS
- Describe the method for resetting a lost Firmware (EFI) password
- Describe how to use Time Machine in macOS to create, restore, and manage a secure data backup

Repairing the Mac Family (34 items)

- Given a simulated workstation, identify the supplies that are necessary to reduce the possibility of damaging the customer's Mac while servicing the computer
- Given a simulated workstation, identify the supplies that are necessary to reduce the possibility of being harmed while servicing Mac models
- Demonstrate the proper and safe handling of batteries and portable computer case assemblies with built-in battery

- Identify specialized tools, fixtures or procedures required to service iMac
- Identify safety precautions necessary to safely service iMac models
- Identify specialized tools, fixtures or procedures required to service iMac Pro
- Identify safety precautions necessary to safely service iMac Pro models
- Identify specialized tools, fixtures or procedures required to service Mac mini
- Identify specialized tools, fixtures or procedures required to service MacBook Pro 13-inch models
- Identify internal connector types for specific MacBook Pro 13-inch models
- Identify specialized tools, fixtures or procedures required to service MacBook Pro 15-inch models
- Identify internal connector types for specific MacBook Pro 15-inch models
- Identify specialized tools, fixtures or procedures required to service MacBook Air
- Identify specialized tools, fixtures or procedures required to service Mac Pro
- Identify internal connector types for specific Mac Pro models
- Identify safety precautions necessary to safely service Mac Pro models
- Identify specialized tools, fixtures or procedures required to service MacBook

Courses in ATLAS

To prepare for the ACMT 2018 Mac Service Certification Exam (MAC-18A), we suggest that you review the courses in the ACMT 2018 subject area in ATLAS. The list of courses in the suggested order can be found in [ACMT 2018 Overview](#).

Frequently Asked Questions

Can anyone take the service certification exams?

Yes. Anyone can take the exams to become an Apple Certified Mac Technician (ACMT) 2018 or Apple Certified iOS Technician (ACiT) 2018. To pass these exams, you need to have access to the training in [ATLAS](#).

Successfully completing the exams doesn't mean that Apple has authorized you to perform repairs or to conduct business directly with Apple or on Apple's behalf. Apple certifies (verifies the skills of) technicians. Apple authorizes (establishes business relationships with) service providers. These two things aren't the same.

How do I register for the exams?

Go to certifications.apple.com to register and create a Tech ID. Then use your [Tech ID](#) to register at an Apple Authorized Training Center or online with Pearson VUE. After you've taken an Apple certification exam, you can track and manage all of your Apple certifications at the certifications website.

How do I prepare for the service certification exams?

Apple provides self-paced training courses in ATLAS through Global Service Exchange (GSX). Apple Authorized Service Providers (AASPs) and Self-Servicing Accounts (SSAs) can get the Service Training curriculum online for free.

The Apple Service Fundamentals Exam (SVC-18A) has sections on ESD precautions and technician safety. You must pass these sections in order to pass the exam as a whole.

If I don't pass an exam, how soon can I retake it?

You can retake an exam 24 hours after completing the last attempt.

How do I pay for the exams?

When you register for the certification exams, you can pay with Visa, MasterCard, or American Express.

Where can I verify my exams or certification status?

To verify your exam and certification status, go to certifications.apple.com. In the "Certification" tab, look for the corresponding Certification Name in "My Certifications" and verify that the status is "Certified". To view exam details, click the relevant Certification Name.

I checked my certification status at certifications.apple.com and it is "In Progress". What does that mean?

If your certifications status is "In Progress", it signifies that not all requirements for the certification were completed. To achieve "Certified" status, some certifications require one or more additional courses or exams to be completed.

I have certifications on two different TechIDs. What should I do?

Your TechIDs will need to be manually updated. Send an email to certifications@apple.com with your exam results and TechID information.

I passed my exam, but when I checked my certification it is not on certifications.apple.com. Why is my certification missing?

Your certifications may take up to 72 hours to appear on certifications.apple.com after you pass the exam. If it has been longer, please send an email to certifications@apple.com.

I have other questions. Where can I get them answered?

You can send your questions to svc.trng@apple.com.

Questions about Apple Certified iOS Technician (ACiT) 2018

What is ACiT 2018?

It's a program to become Apple-certified as an iOS technician.

How is ACiT 2018 different from previous ACiT 2017 certification?

ACiT 2018 qualifies a technician to repair iOS products that were produced before April 2018. This includes:

- iPhone 8 and iPhone 8 Plus
- iPhone X
- iPad (6th generation)

What exams are required for ACiT 2018?

To get ACiT 2018 certification, you need to pass the Apple Service Fundamentals Exam (SVC-18A) or (SVC-17A) and the ACiT 2018 iOS Service Certification Exam (iOS-18A). These exams are available from Pearson VUE. You can take the exams online from your own computer.

Does it matter in what order I take the exams?

Yes. Before you can register for the ACiT 2018 iOS Service Certification Exam (iOS-18A), you must pass the Apple Service Fundamentals Exam.

How much does each exam cost?

The cost of the exam is \$20 USD (2,215 yen for Japan). Current pricing is available from Apple Authorized Training Centers or [Pearson VUE](https://www.pearsonvue.com).

Where do I find the training for these exams?

Training for these exams is available in [ATLAS](https://atlas.apple.com). Access ACiT 2018 courses at Apple-authorized service facilities.

I'm already ACiT 2017 certified. Do I need to take the new ACiT 2018 exams?

No. If you're certified for the iOS products you need to repair, no new exams are required.

Will separate iOS qualification exams be required for new iOS products?

No. Apple will introduce new qualification courses in ATLAS as products are introduced. You have to complete these courses to service these new products.

I've completed the SVC-17A exam. How long will the iOS-17A exam be available? Do I need to take two new exams for ACiT certification?

If you've completed the SVC-17A for ACiT 2017, the ACiT exam will be available until July 27, 2018. Until then, completion of SVC-17A and iOS-17A exams will still grant you ACiT 2017 certification, but it won't cover as many products. To get ACiT 2018 certification, the SVC-18A and iOS-18A exams are required.

What will I have to do to service new iOS products that are introduced after I'm certified?

Apple will introduce new qualification courses in ATLAS as products are introduced. You have to complete these courses to service these new products.

I have completed the Apple Certified Mac Technician (ACMT) 2018 certification. Do I need to take two new exams for ACiT certification?

No. If you're ACMT 2018 certified, you've passed the Apple Service Fundamentals Exam. You only need to pass the ACiT 2018 iOS Service Certification Exam (iOS-18A) to be ACiT 2018 certified.

When I complete the requirements for ACiT 2018, will I get a printed certificate?

Yes. After you pass the required exams, send an email to certifications@apple.com and ask for a certificate. You'll get an email with a link to the request form.

I have other questions. Where can I get them answered?

You can send your questions to svc.trng@apple.com.

Questions about Apple Certified Mac Technician (ACMT) 2018

What is ACMT 2018?

Apple Mac Technician (ACMT) 2018 is a new version of the Apple Certified Mac Technician certification.

How is ACMT 2018 different from previous ACMT certifications?

ACMT 2018 qualifies a technician to repair all the Mac products that were covered by prior ACMT certifications, plus all other Mac products that were produced before April 2018. This includes MacBook and MacBook Pro products that required a separate qualification exam or course in ATLAS:

- MacBook (Retina, 12-inch, 2017)
- MacBook Air (2017)
- MacBook Pro (13-inch, 2017, Four Thunderbolt 3 Ports)
- MacBook Pro (13-inch, 2017, Two Thunderbolt 3 Ports)
- MacBook Pro (15-inch, 2017)
- iMac Pro (2017)
- iMac (2017)

ACMT 2018 allows a technician who works at an Apple-authorized service facility to service all of these products.

What exams are required for ACMT 2018?

To get ACMT 2018 certification, you need to pass the Apple Service Fundamentals Exam (SVC-18A) or (SVC-17A) and ACMT 2018 Mac Service Certification Exam (MAC-18A). These exams are available from Pearson VUE. You can take the exams online from your own computer.

Does it matter in what order I take the exams?

Yes. Before you can register for the ACMT 2018 Mac Service Certification Exam (MAC-18A), you must pass the Apple Service Fundamentals Exam.

How much do each of the exams cost?

The cost of the exam is \$20 USD (2,215 yen for Japan). Current pricing is available from Apple Authorized Training Centers or [Pearson VUE](#).

Where do I find the training for these exams?

Training for these exams is available in [ATLAS](#). You can access ACMT 2018 courses at Apple authorized service facilities.

I'm already ACMT 2017 certified. Do I need to take the new ACMT 2018 exams?

No. If you're certified for the Mac products you need to repair, no new exams are required.

I've completed the Apple Certified iOS Technician (ACiT 2018) certification. Do I need to take two new exams for ACMT certification?

No. If you're ACiT 2018 certified, you've already passed the Apple Service Fundamentals Exam. You only need to take and pass the ACMT 2018 Mac Service Certification Exam (MAC-18A) to be ACMT 2018 certified.

Will separate Mac qualification exams still be available?

Apple will publish new qualification courses in ATLAS for new Apple products as needed. If you're already ACMT certified and want to repair a product with separate course requirements, you'll be able to do so.

I've completed one of the previous ACMT 2017 exams. Do I need to take two new exams for ACMT certification?

If you've completed the SVC-17A exam for ACMT, the remaining ACMT exam will be available until July 27, 2018. Until then, completion of SVC-17A and MAC-17A exams will still grant you ACMT 2017 certification, but it won't cover as many products. To get ACMT 2018 certification, the SVC-18A / SVC-17A and MAC-18A exams are required.

What will I have to do to service new Mac products that are introduced after I'm certified?

Apple will introduce new qualification courses in ATLAS as products are introduced. You have to complete these courses to service the new products.

When I complete the requirements for ACMT 2018, will I get a printed certificate?

Yes. After you pass the required exams, send an email to certifications@apple.com and ask for a certificate. You'll get an email with a link to the request form.

I have other questions. Where can I get them answered?

You can send your questions to svc.trng@apple.com.

Mac mini (2018) Required Tools

Mac mini (2018) Required Tools

The following tools are required to service the computer:

- ESD wrist strap and mat
- ESD-safe tweezers
- Screw tray
- Black stick (922-5065)
- Antenna tool (923-01322)
- Painter's tape (1–2 in. wide)

- Torx T5 screwdriver
- Torx T6 screwdriver
- Torque driver, adjustable, 0.3–1.2 Newton meters (Nm) (923-0735)
- Torx T6 security bit (923-00304)
 - Used for antenna plate screws
- Torx T10 bit (923-0740)
 - Used for logic board screws

Note: For more information on purchasing tools, refer to [OP101: Hand Tools for Repairs](#).

Cosmetic Care

Cosmetic surfaces have a high exposure to potential damage or scratching. Be careful not to damage the housing and other cosmetic surfaces with inadvertent tool movements. As a precaution, apply painter's tape around the housing edges, especially when handling the antenna plate. In general, avoid scratching interior or exterior surfaces.

Take Apart Procedure Notes

Reassembly Steps

When no replacement steps are listed, replace parts in exact reverse order of Removal procedure.

Note About Images in This Guide

In some cases a pre-production model may have been used to document the procedures in this guide. Although there may be small differences in appearance between the image pictured and the computer you are servicing, the procedures are the same unless noted.

Screw Sizes

All screw sizes shown are approximate and represent the total length of the screw.



Mac mini (2018) Bottom Cover

First Steps



Warning:

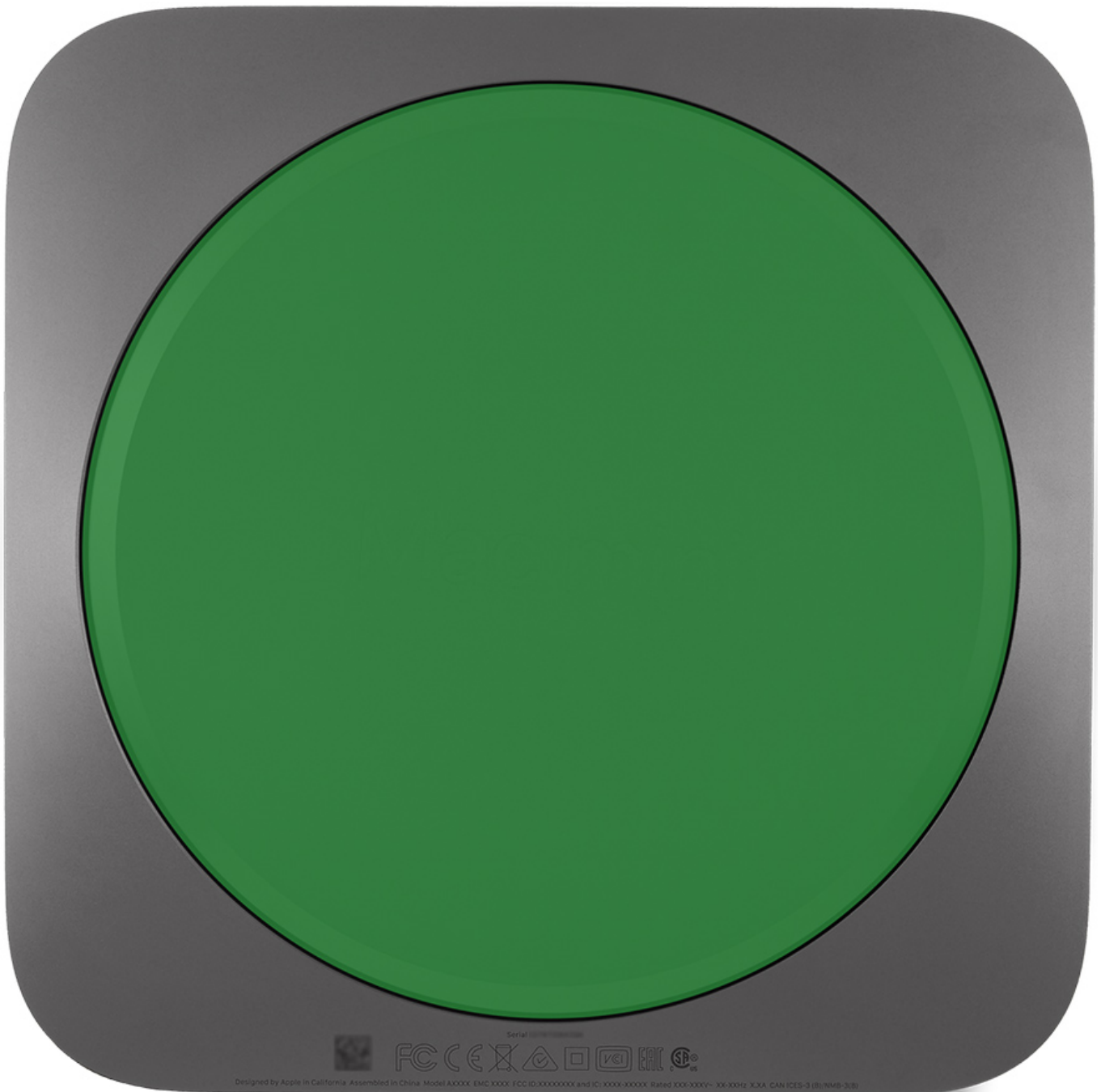
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Before you begin:

- Shut down the computer.
- Unplug all cables.
- Place the computer on a clean, flat surface.



Tools

- Black stick



Steps For Removal

1. Place the flat end of the black stick between the bottom cover and housing.



2. Rotate the black stick around the edge of the bottom cover. Listen for three audible clicks as the bottom cover clips disengage from the antenna plate screws below.



3. Lift away the bottom cover.



Steps For Reassembly

1. Align the clips on the underside of the bottom cover with the antenna plate screws.



2. Press down to engage the bottom cover clips with the antenna plate screws below.



Mac mini (2018) Antenna Plate

First Steps



Warning:

- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Cover](#)



Tools

- Torx T6 security bit (923-00304)
- Adjustable torque driver 0.3–1.2 Nm (923-0735)
- Torx T6 screwdriver (magnetized)
- Black stick
- ESD-safe tweezers
- Antenna tool (923-01322)



Steps For Removal

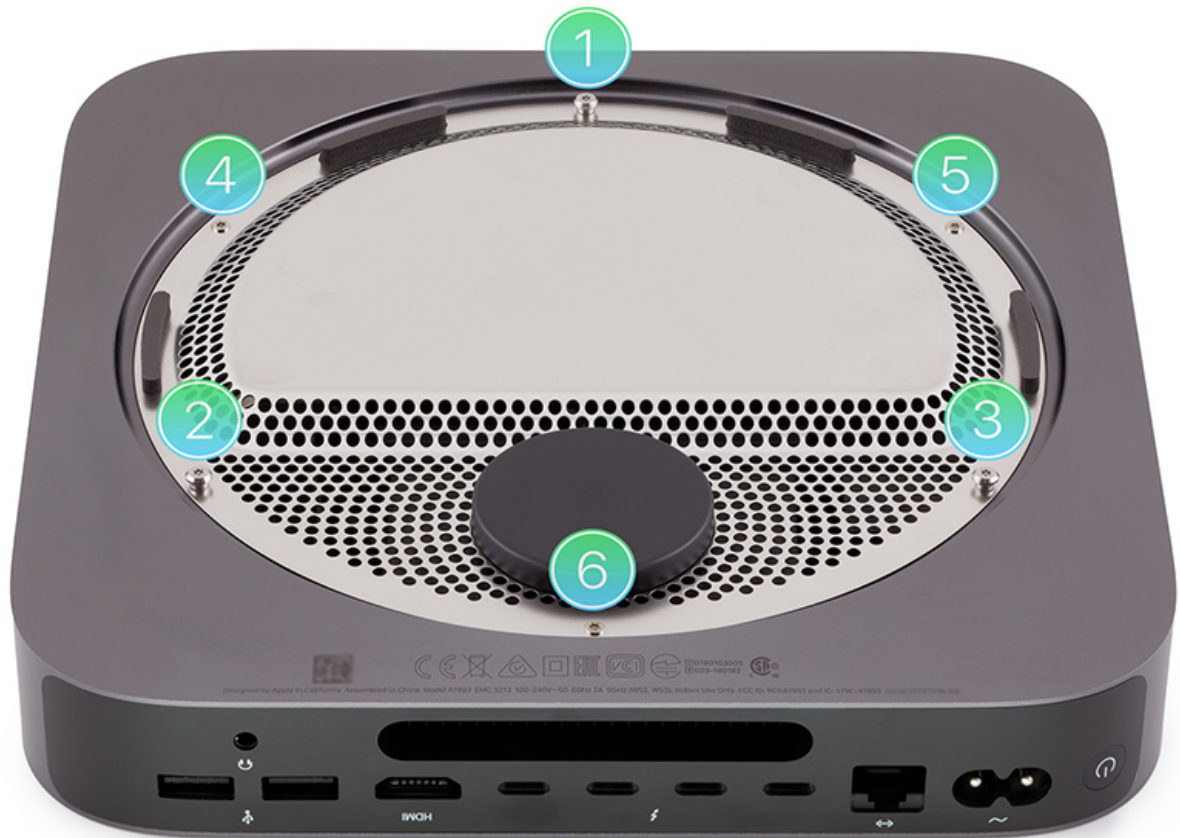
1. Use the adjustable torque driver set to 0.3 Nm with the T6 security bit to remove six T6 security screws in the order shown.

- Screws 1, 2, 3 = 923-00157
Torque value: 0.3 Nm

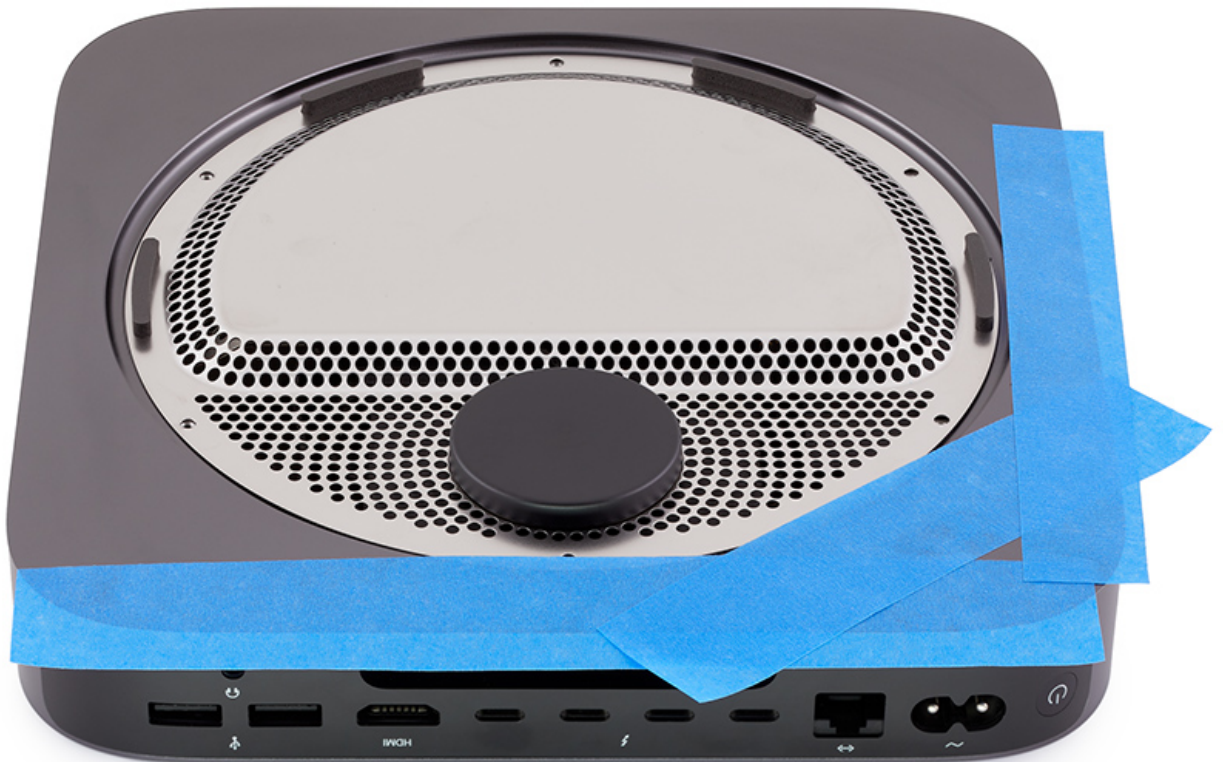


- Screws 4, 5, 6 = 923-00155
Torque value: 0.3 Nm





2. To avoid damage to the enclosure, apply painter's tape to the inner edges of the housing.

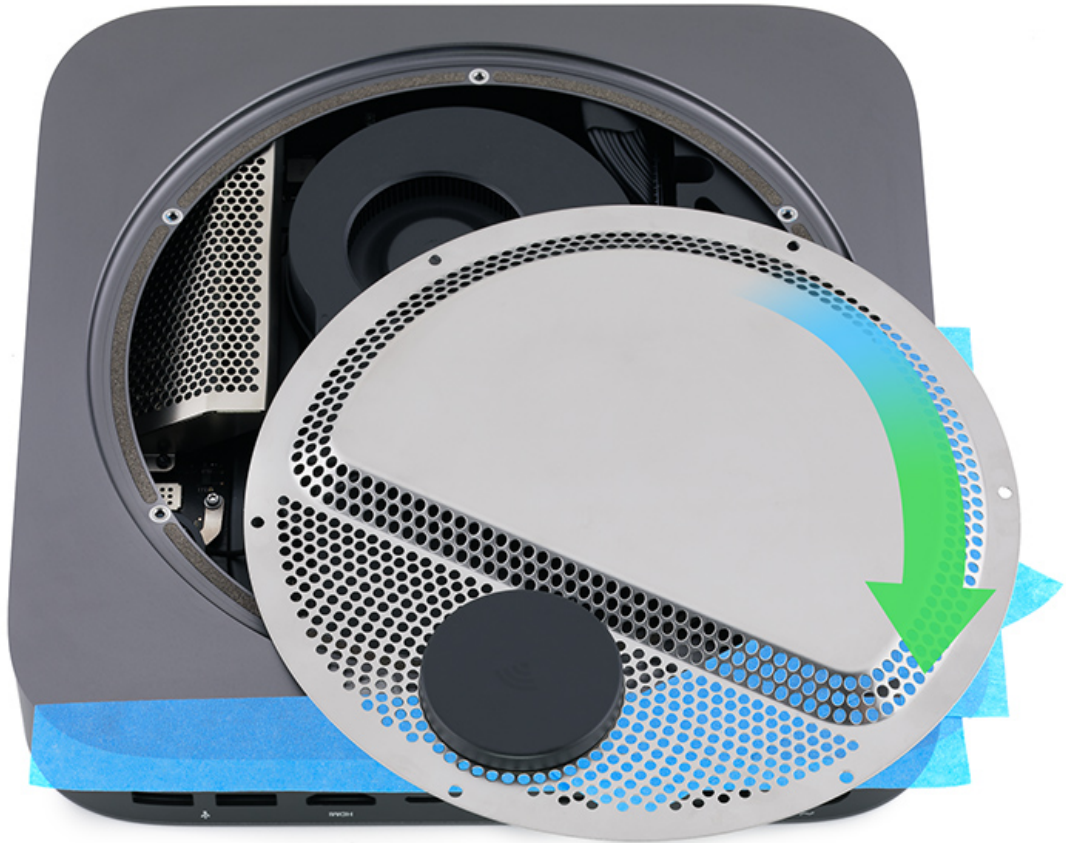


3. Use a black stick to slightly lift the antenna plate.

Caution: The antenna plate is attached to the logic board by the antenna cable and T6 ground screw.



4. Rotate the antenna plate clockwise to access the antenna ground screw.



5. Remove the T6 antenna ground screw.

- T6: 923-03034



6. Use the antenna tool to disconnect the antenna cable from the logic board, then lift away the antenna plate.



Steps For Reassembly

1. Loosely install the T6 antenna cable ground screw.

- T6: 923-03034





2. Align the antenna cable head above the antenna connector on the logic board.



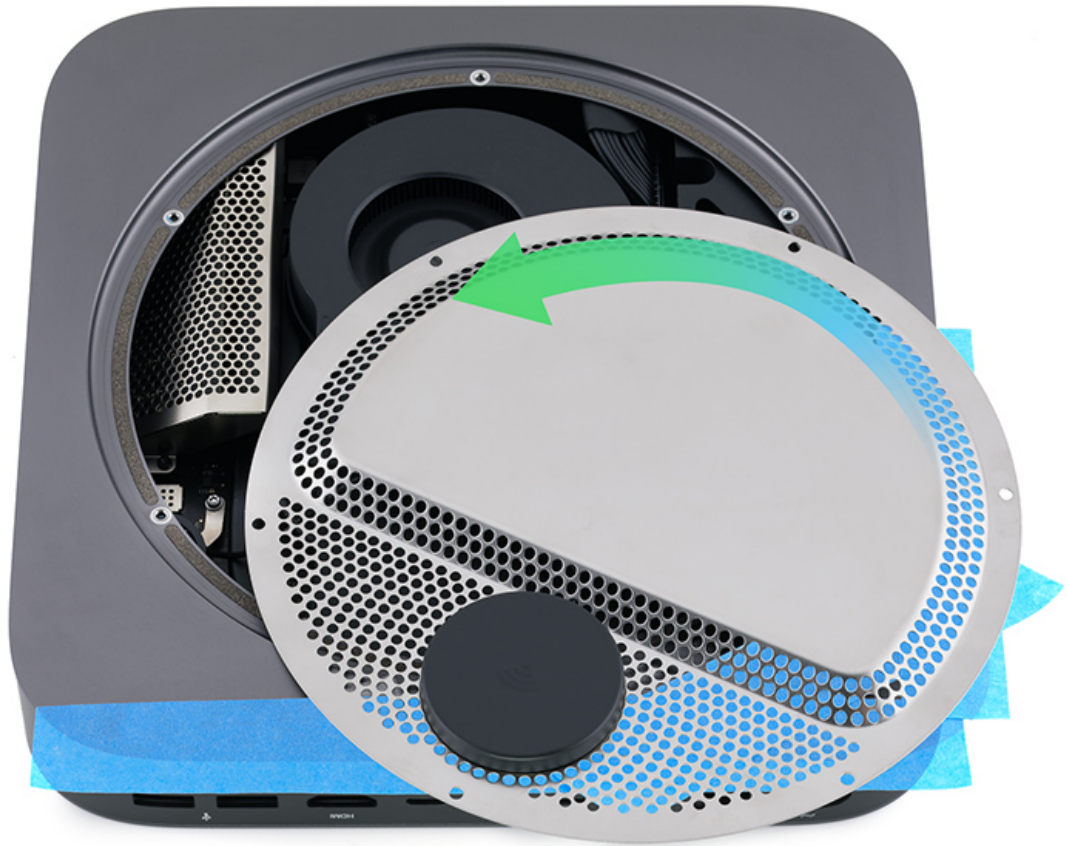
3. Use the flat end of the antenna tool to press the antenna cable head onto the connector.



4. Tighten the T6 ground screw.



5. Rotate the antenna plate counterclockwise. Align the screw holes of the antenna plate and housing.



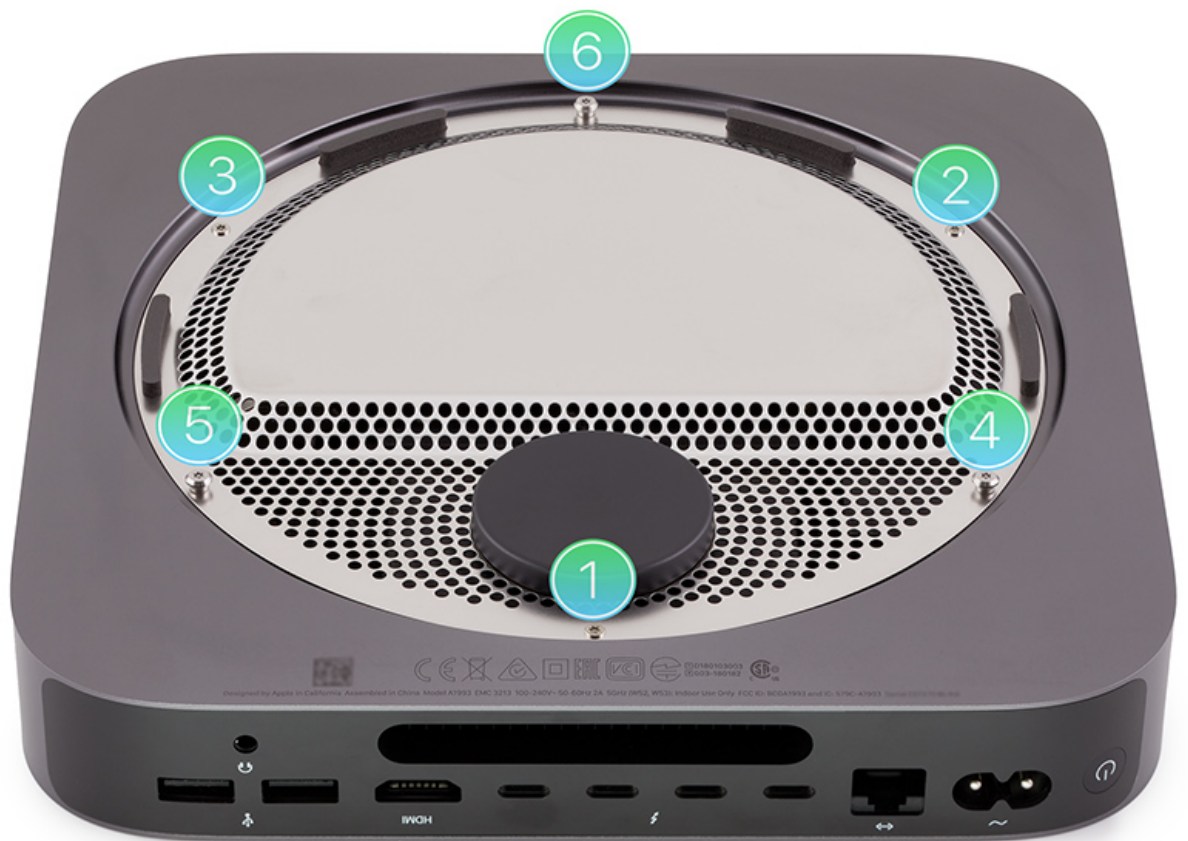
6. Use the adjustable torque driver set to 0.3 Nm with the T6 security bit to reinstall the six T6 security screws in the order shown.

- Screws 1, 2, 3 = 923-00155
Torque value: 0.3 Nm



- Screws 4, 5, 6 = 923-00157
Torque value: 0.3 Nm





7. Reinstall the [bottom cover](#).

Mac mini (2018) Fan

First Steps



Warning:

- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Cover](#)
- [Antenna Plate](#)



Tools

- Black stick
- Torx T6 screwdriver (magnetized)

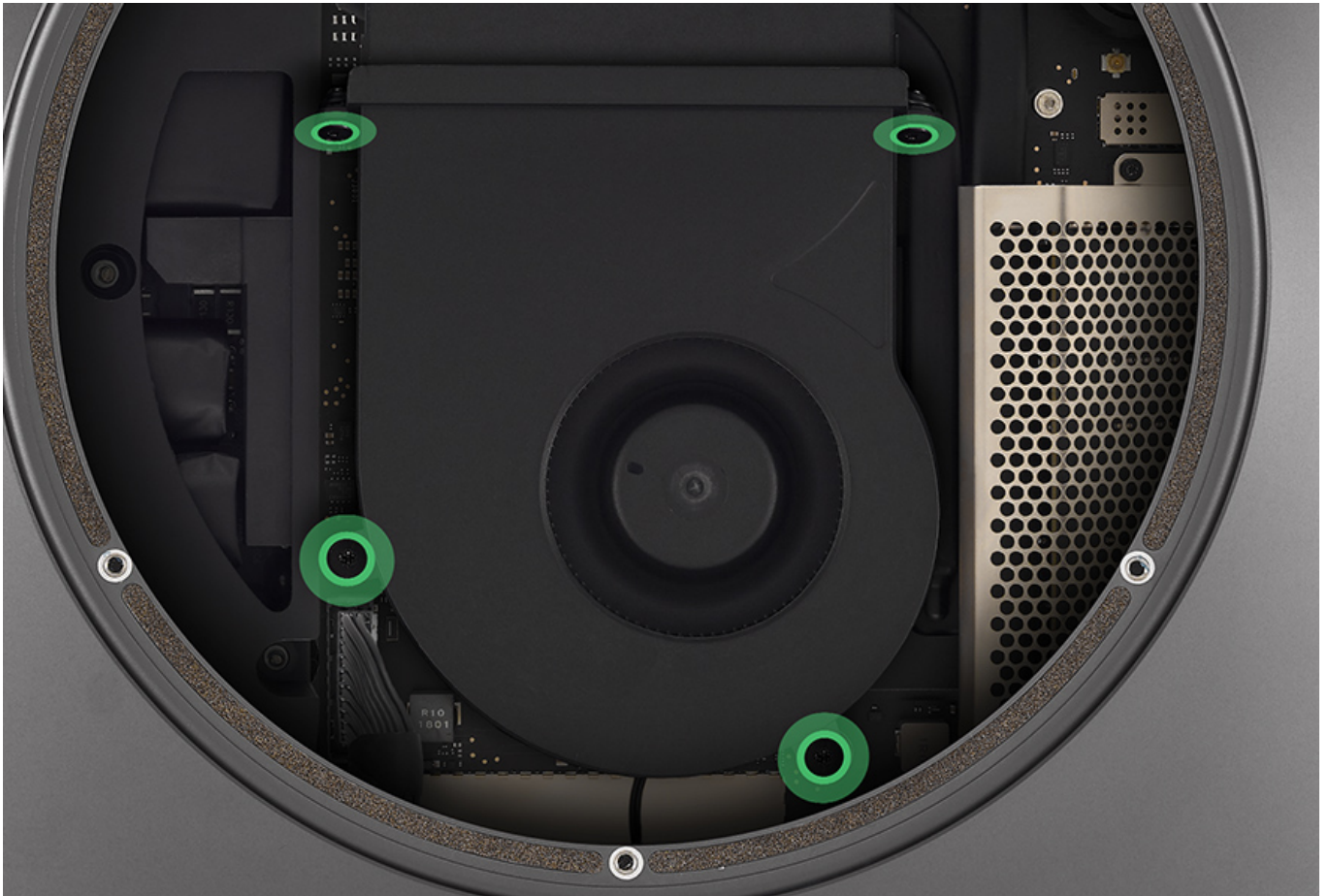


Steps For Removal

1. Remove the four T6 fan screws.

Note: The two upper screws are installed at an angle.

- T6: 923-02803

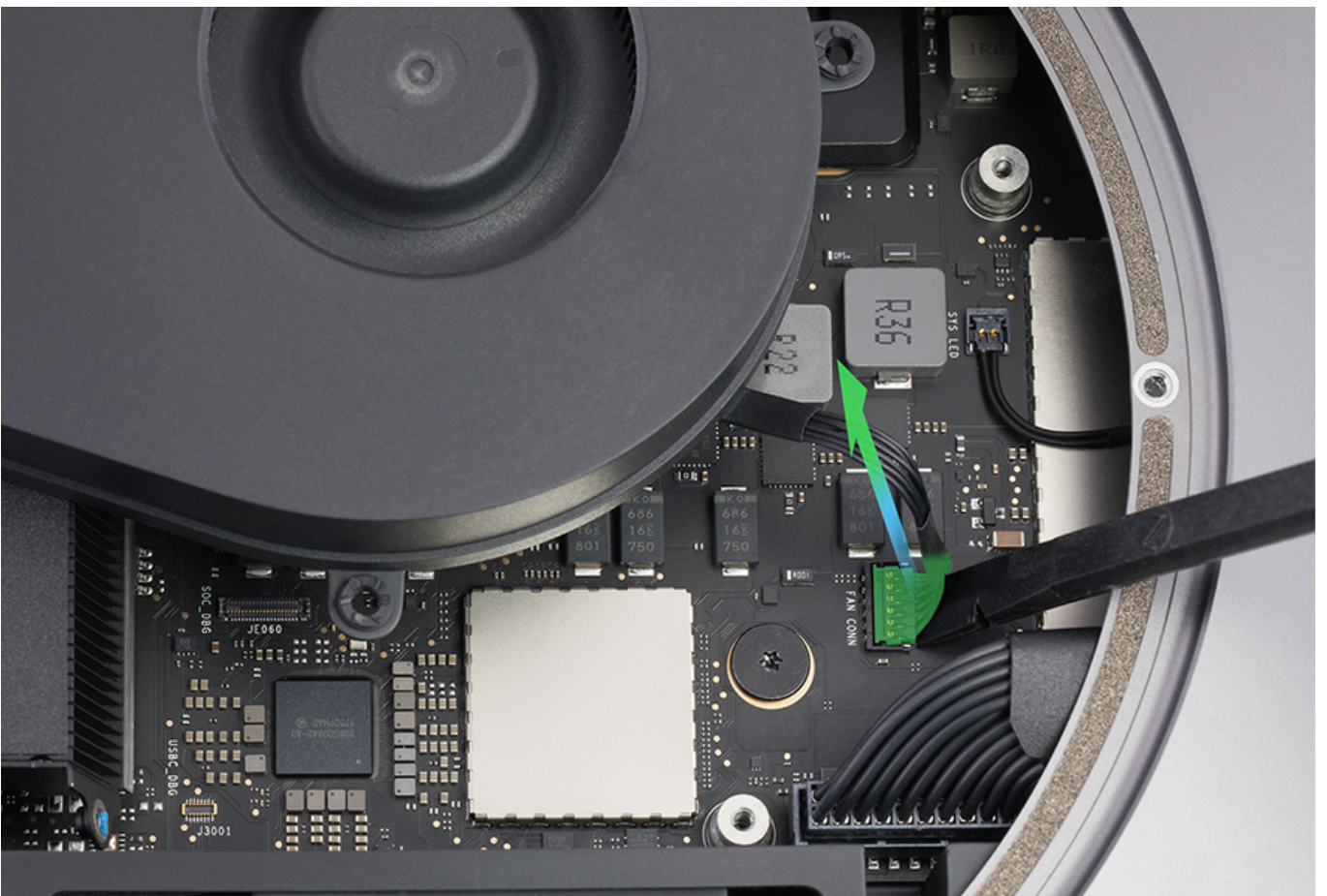


2. The fan cable connects to the logic board directly beneath the fan assembly. Slightly lift the fan up and to the side.



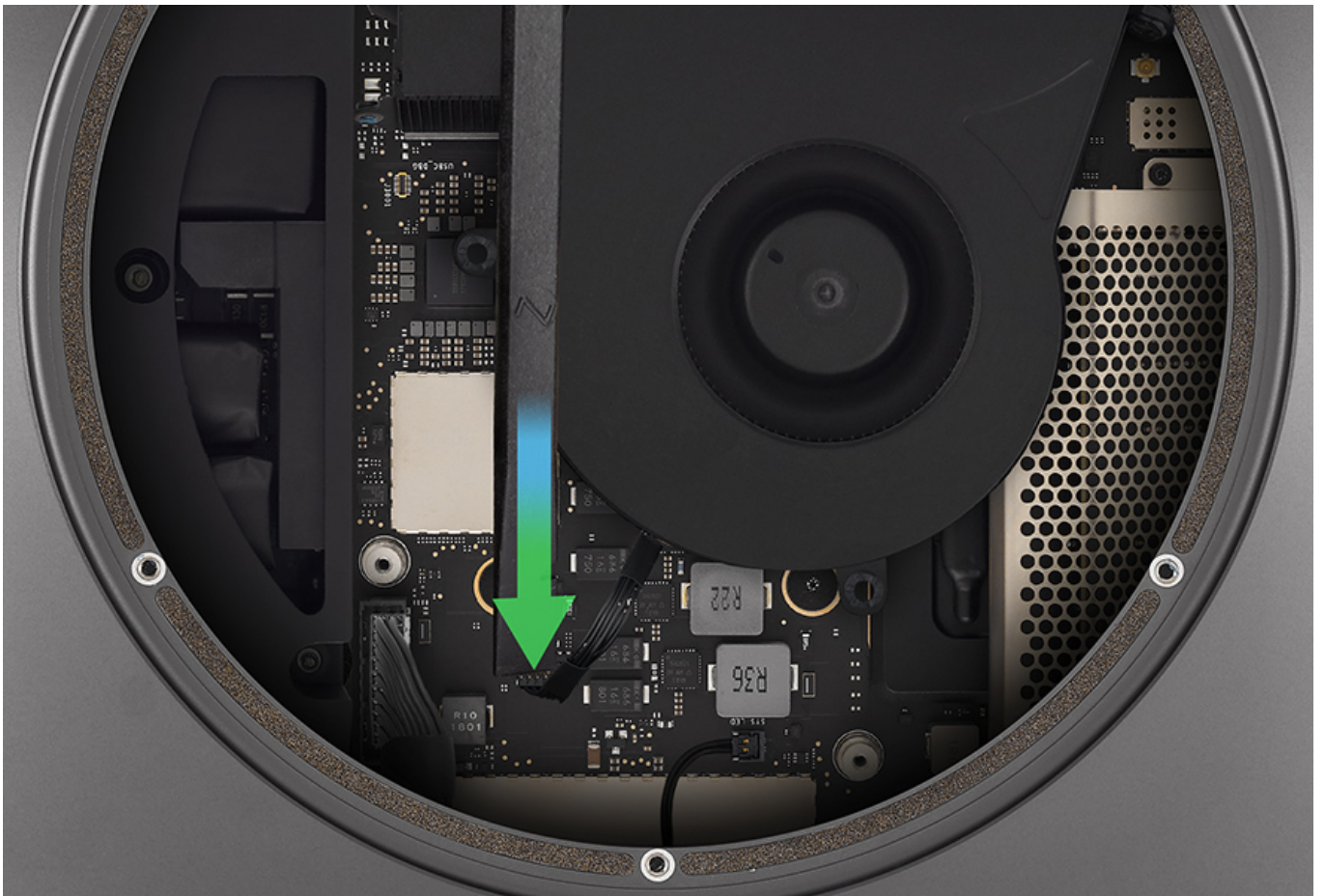
3. Use a black stick to disconnect the fan cable from the logic board.

Note: The image is rotated 90 degrees counterclockwise to provide a better view of the cable.



Steps For Reassembly

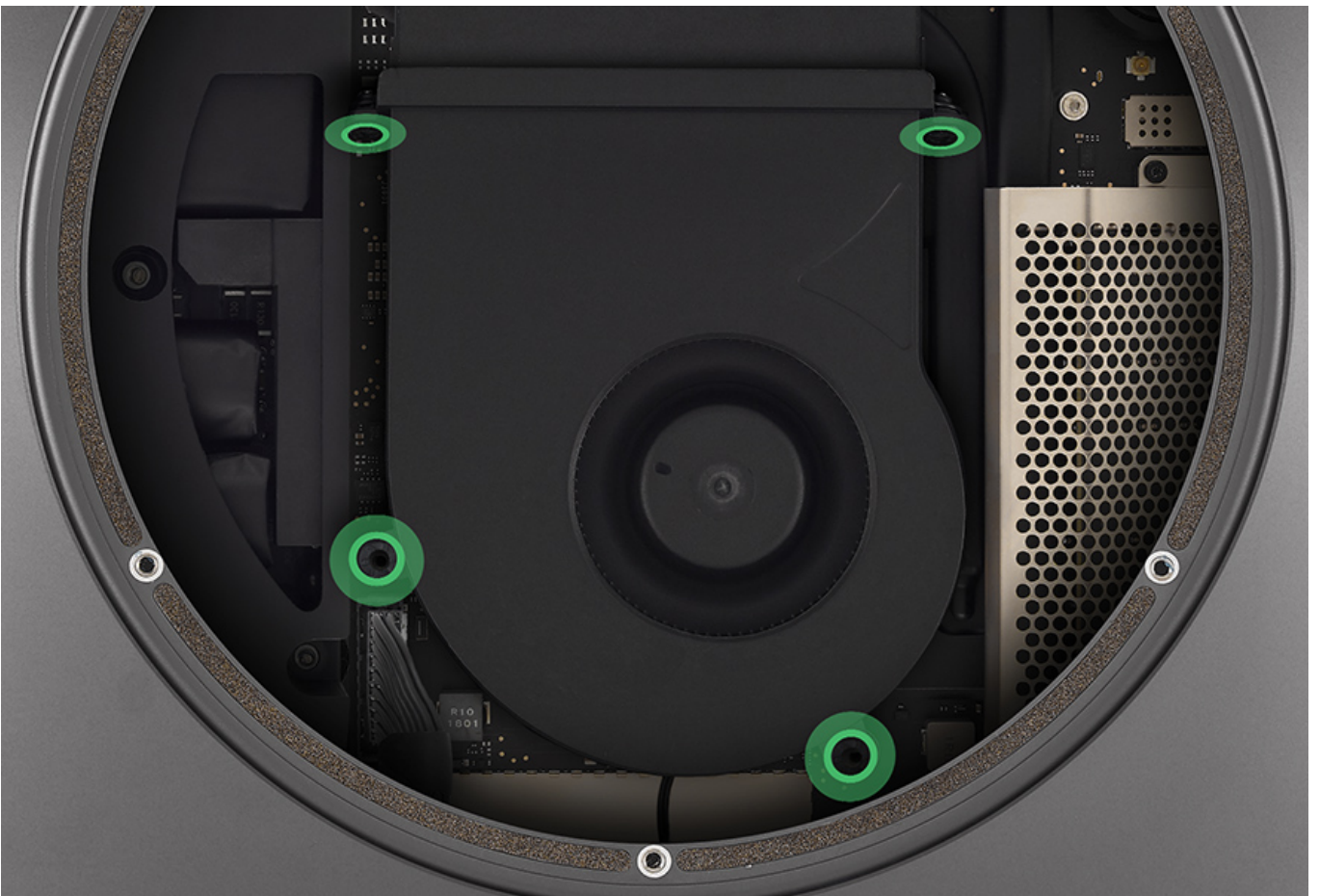
1. Reconnect the fan cable.



2. Align the fan with the standoffs and reinstall the four T6 fan screws.

- T6: 923-02803





3. Reinstall the [antenna plate](#).
4. Reinstall the [bottom cover](#).

Mac mini (2018) Logic Board

First Steps



Warning:

- Do not apply external power while the computer is under repair.

Important:

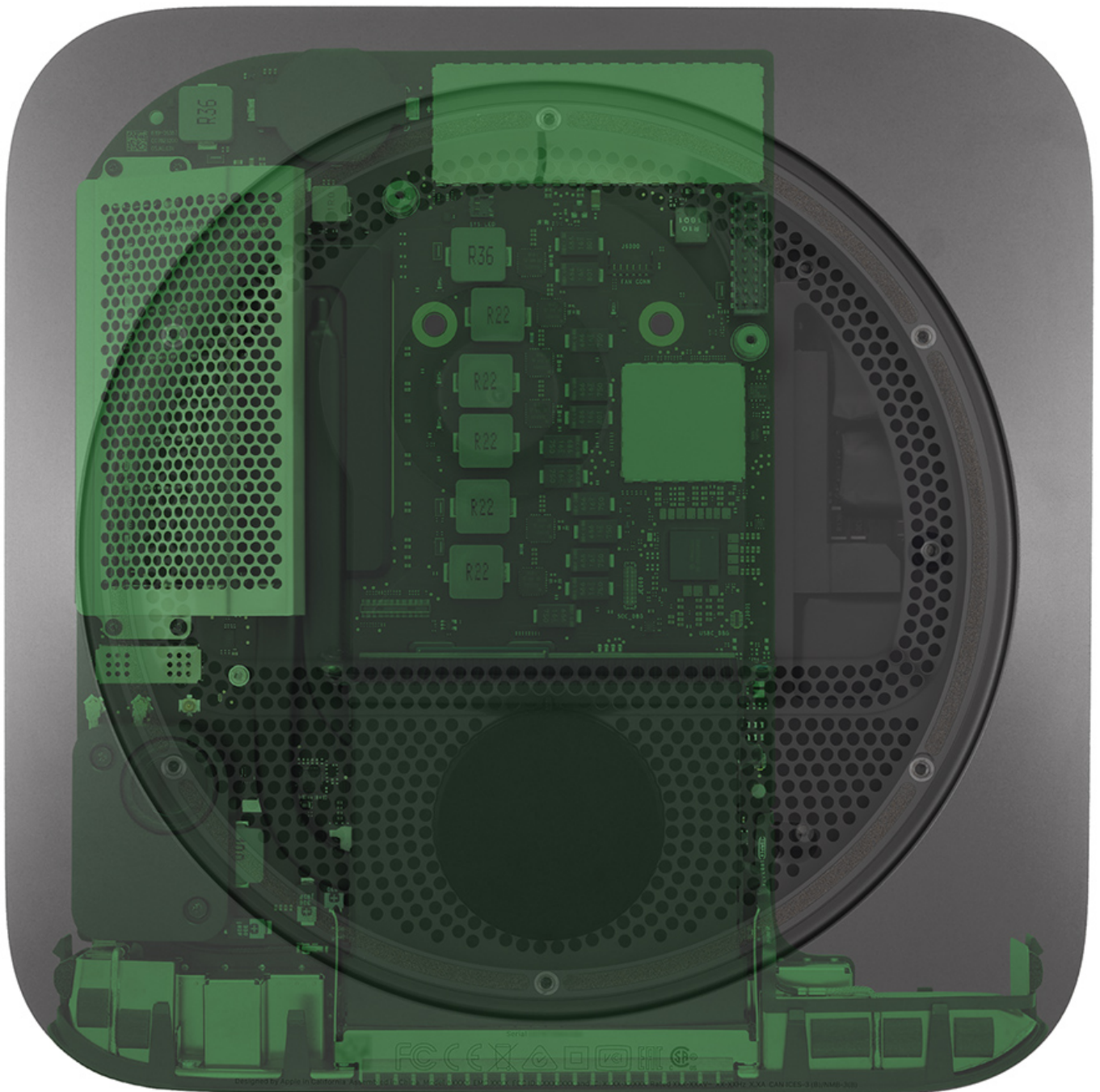
- This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

System Configuration:

- If replacing the logic board, the repair is not complete until System Configuration has been performed. For instructions, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#). Failure to perform this step will result in an inoperative system and an incomplete repair.

Remove:

- [Bottom Cover](#)
- [Antenna Plate](#)
- [Fan](#)



Tools

- Torx T10 bit (923-0740)
- Adjustable torque driver 0.3–1.2 Nm (923-0735)
- Black stick
- ESD tweezers

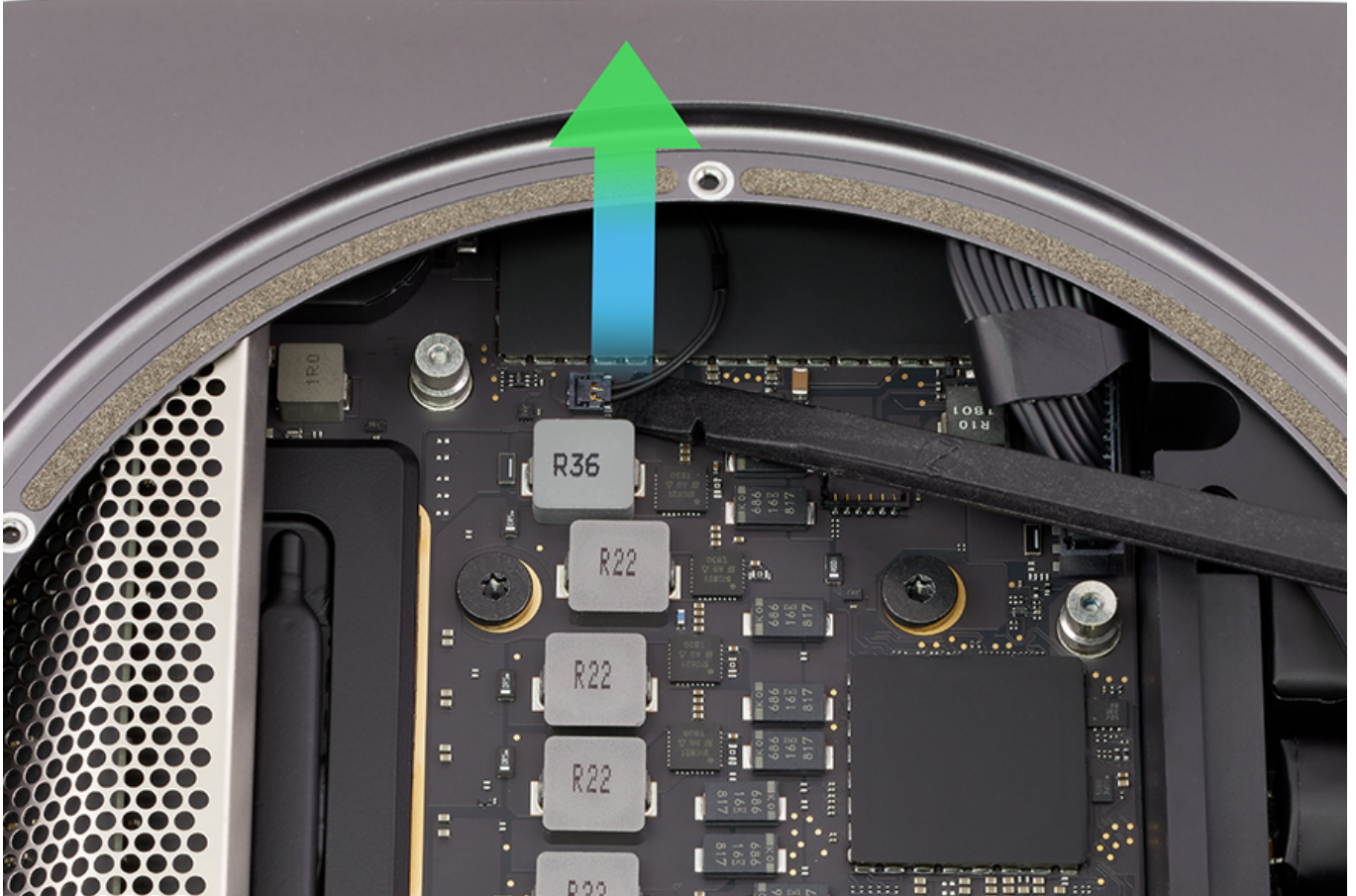


Steps For Removal



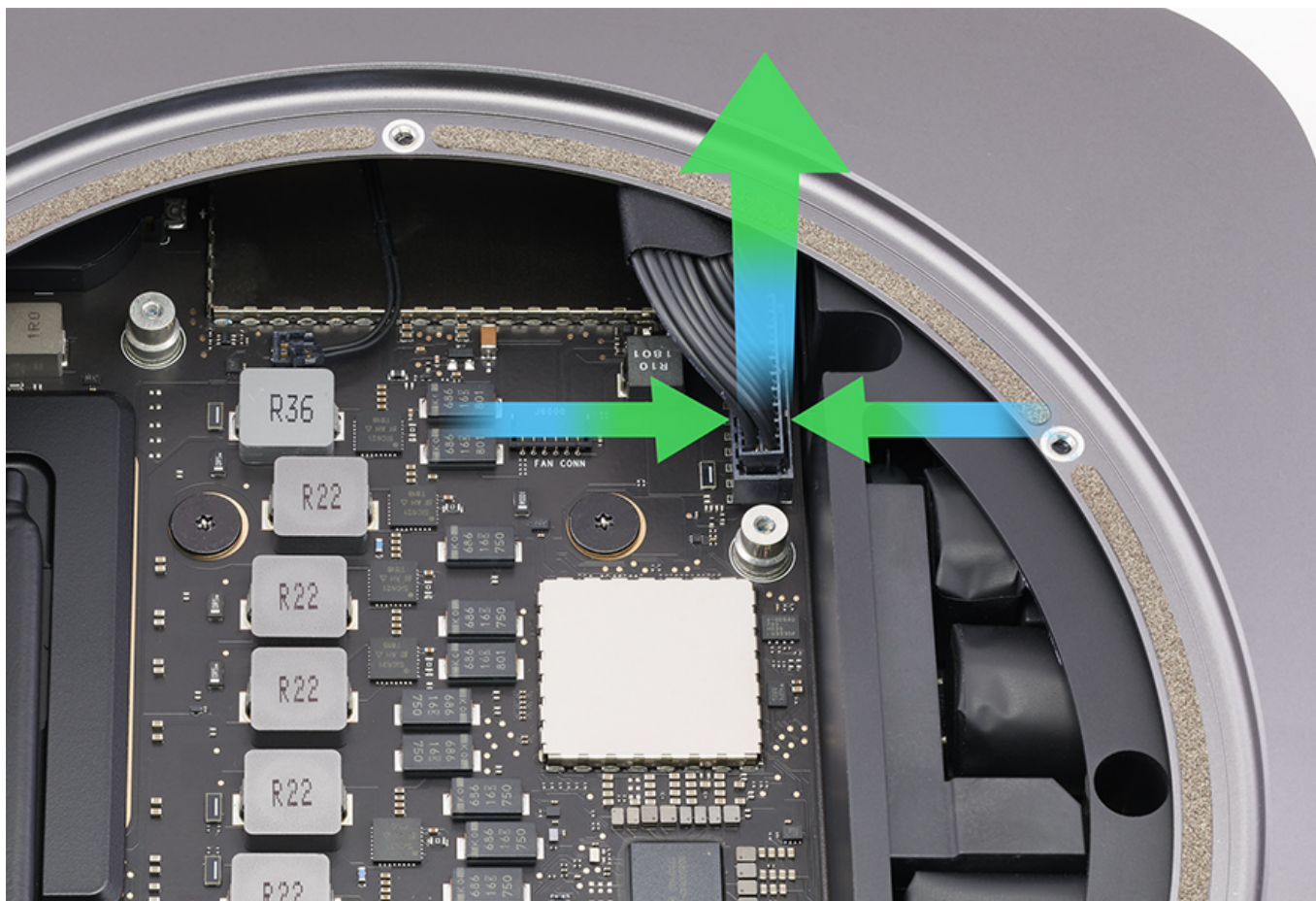
Important: Mac mini (2018) may appear to have no power after a logic board replacement until System Configuration has been performed. Failure to perform the configuration will result in an inoperative system and an incomplete repair. For instructions, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#).

1. Disconnect the status indicator light (SIL) cable from the logic board.



2. Pinch the power supply cable firmly between your fingers and pull up.

Note: The cable requires some force to disconnect from the logic board connector. Wiggle the cable as you pull up.

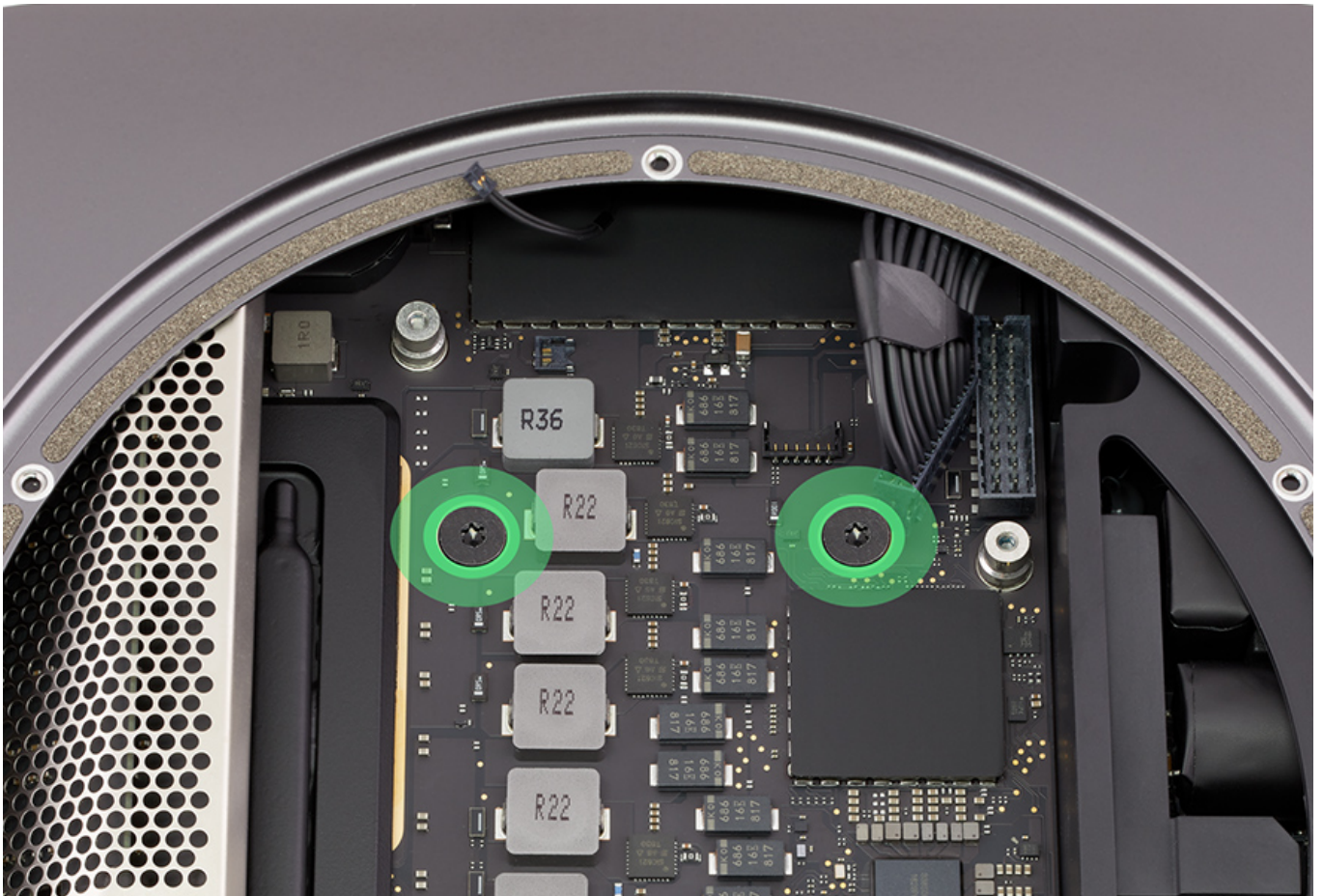


3. Use the adjustable torque driver set to 1.2 Nm with the T10 Torx bit to remove the two logic board screws.

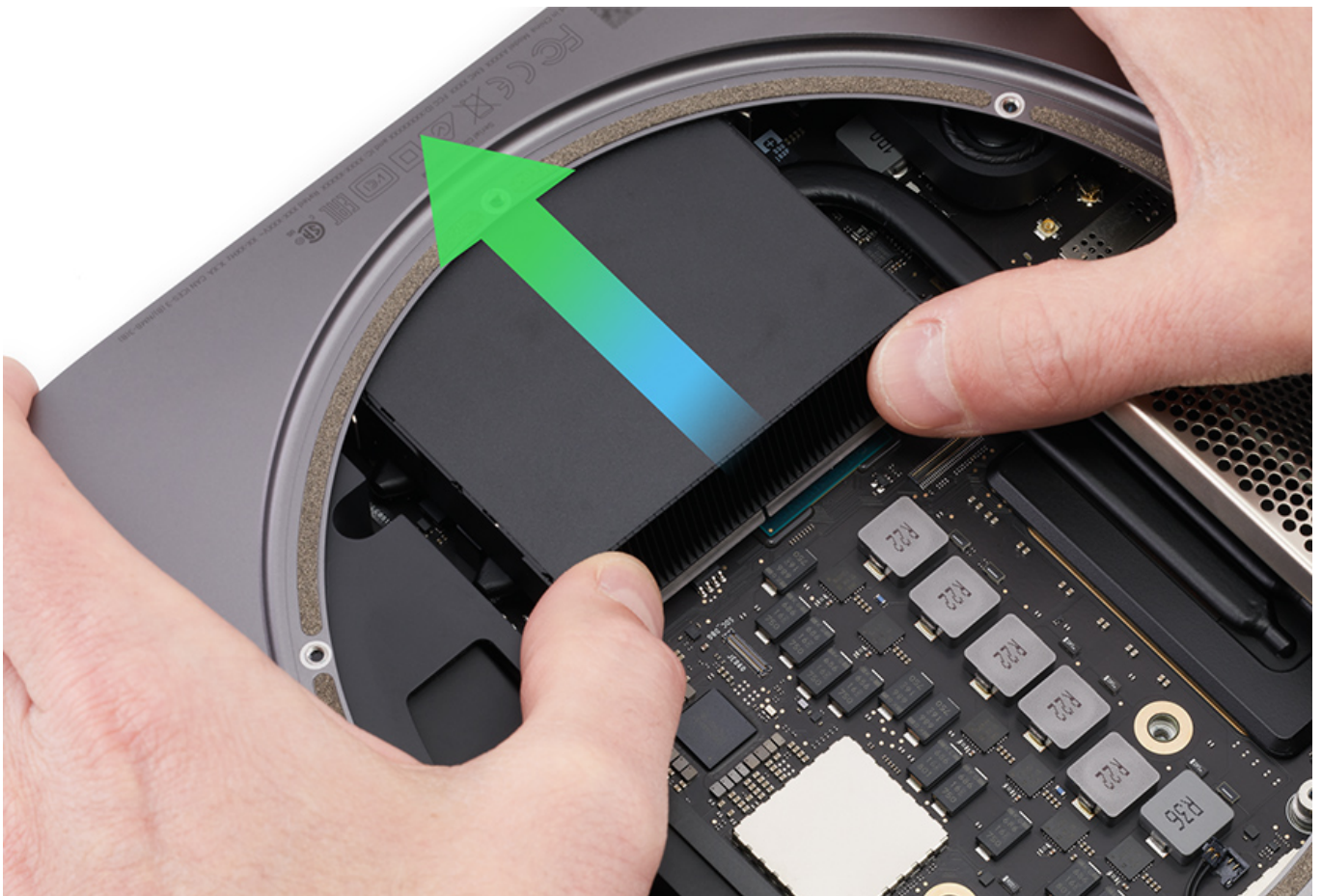
- T10: 923-02802

Note: torque value = 1.2 Nm





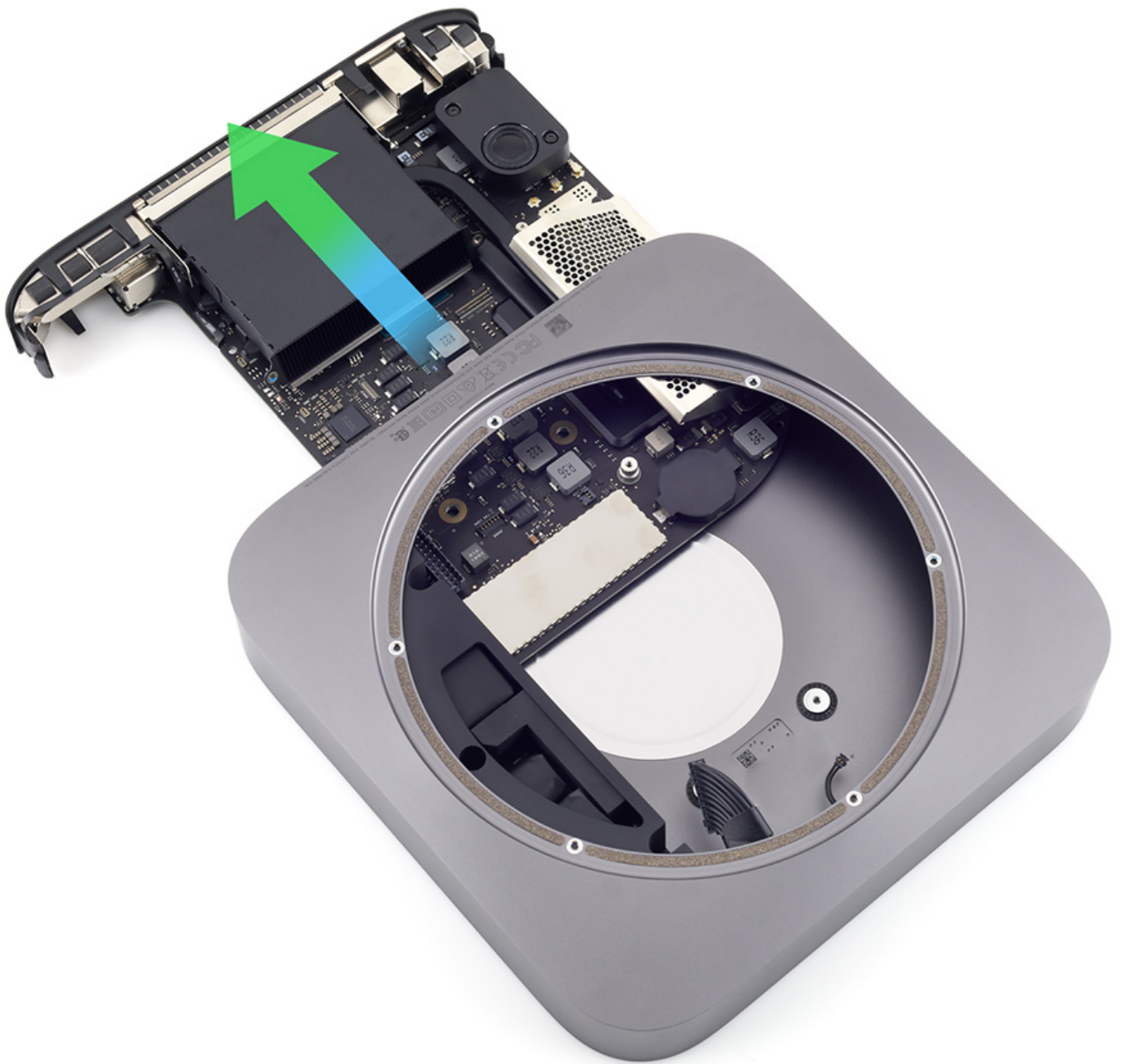
4. Push on the heat sink to slide the logic board out of the housing about 1 inch (2.5 cm).



5. Lift the SIL cable and power supply cable so the logic board can slide unobstructed.



6. Continue to push forward on the heat sink to fully remove the logic board from the housing.

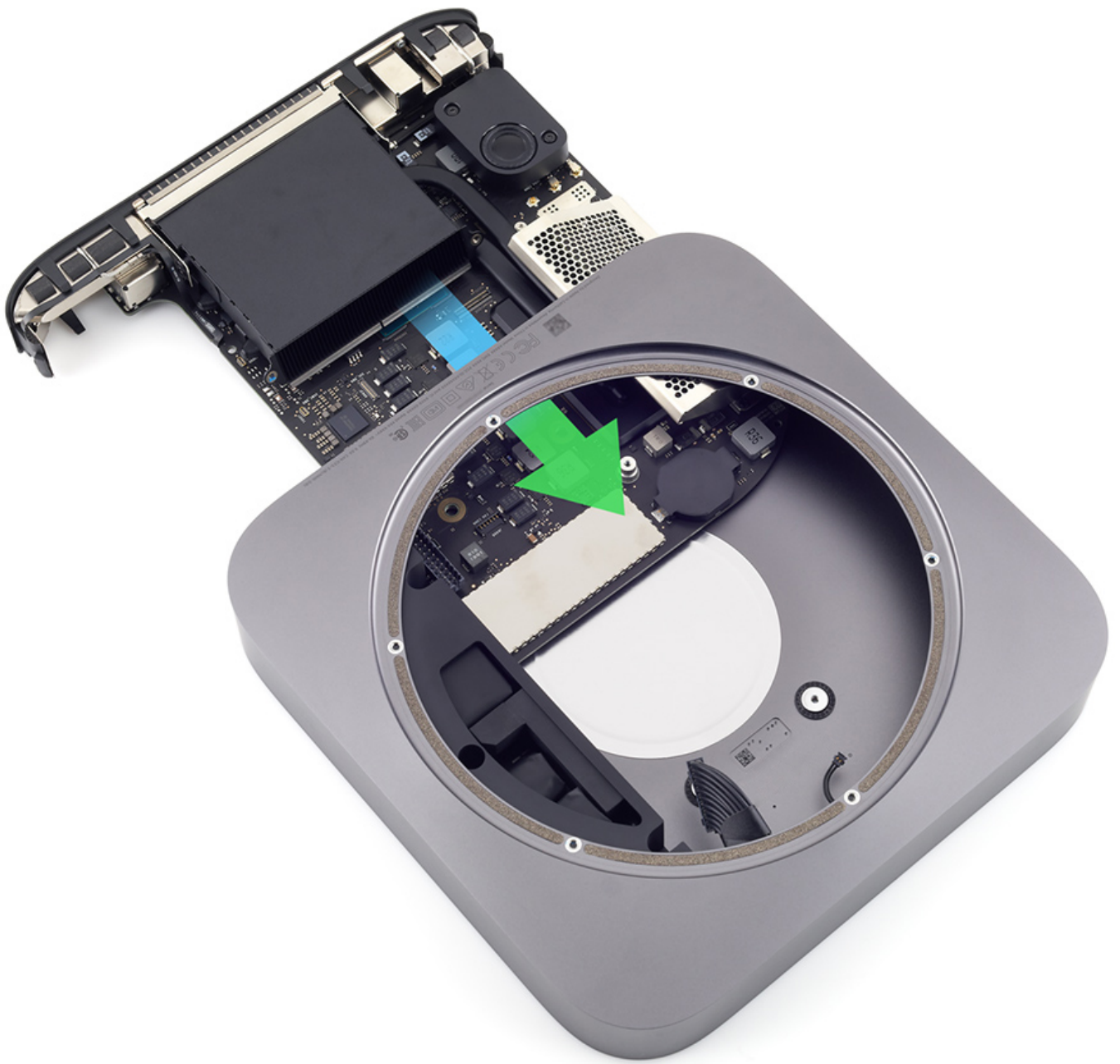


Steps For Reassembly

Note: If you are installing a replacement logic board, transfer the following parts from the old logic board:

- [Speaker](#)
- [I/O Wall](#)
- [Memory](#)
 - A replacement logic board ships with a protective film over the memory slots. Remove the film before installing the memory.

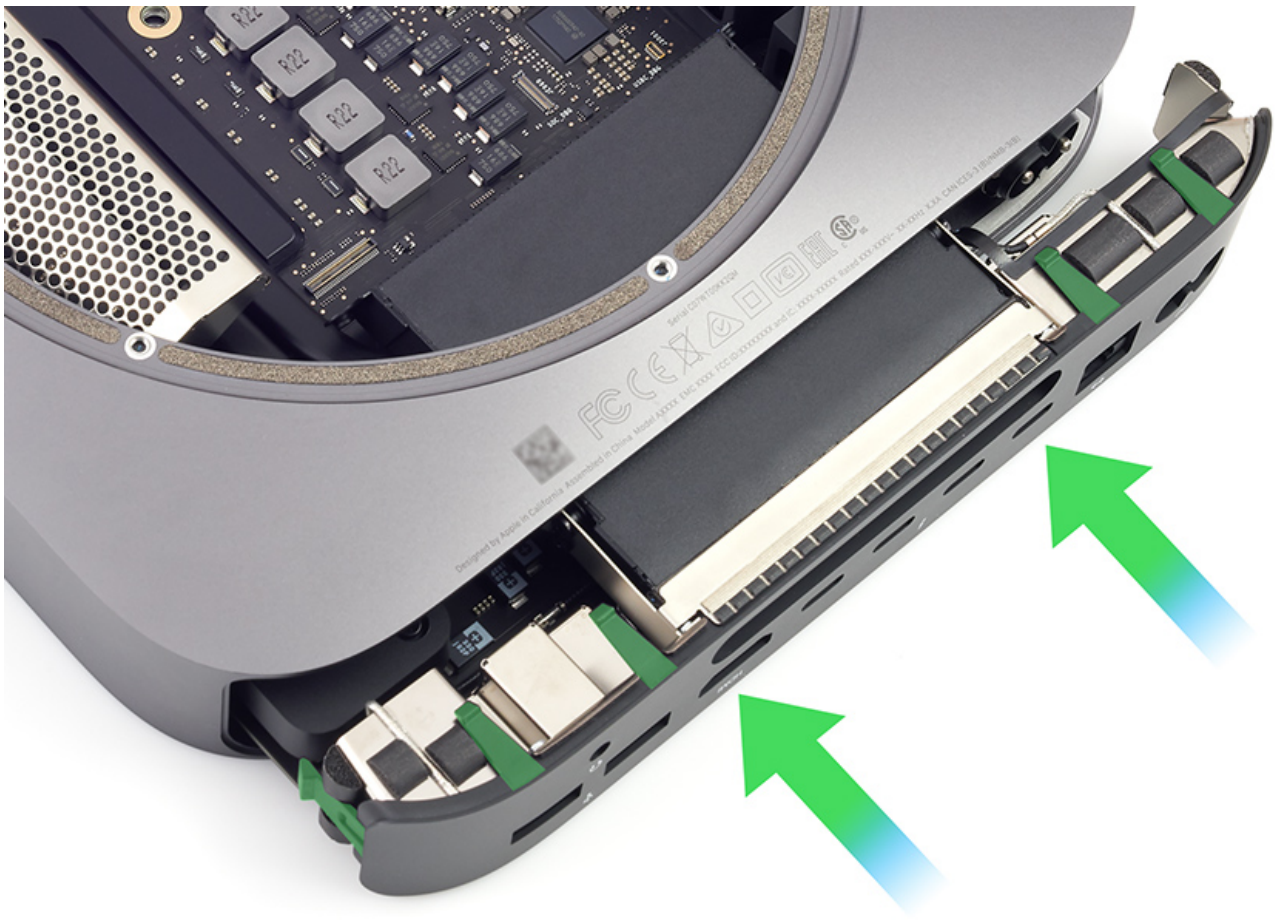
1. Slide the logic board into the housing.



2. Lift the SIL cable and power supply cable out of the way as you slide the logic board into the housing.



3. Push forward on the I/O wall until the I/O wall clips engage with the housing.



4. Use the adjustable torque driver set to 1.2 Nm with the T10 Torx bit to reinstall the two logic board screws.

- T10: 923-02802

Note: torque value = 1.2 Nm





5. Reconnect the SIL cable and power supply cable.



6. Reinstall the [fan](#).

7. Reinstall the [antenna plate](#).

8. Reinstall the [bottom cover](#).
9. If you installed a replacement logic board, run [System Configuration](#).



Important: Mac mini (2018) may appear to have no power after a logic board replacement until System Configuration has been performed. Failure to perform the configuration will result in an inoperative system and an incomplete repair. For instructions, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#).

System Configuration for Macs with the Apple T2 Security Chip

For Macs with the Apple T2 Security Chip, the repair process is not complete for certain parts replacements until the AST 2 System Configuration suite has been run. Failure to perform this step will result in an inoperative system and an incomplete repair.

- For MacBook Pro (2018): Display assembly, logic board, top case, and Touch ID board
- For MacBook Air (Retina, 13-inch, 2018): Logic board and Touch ID board
- For iMac Pro: Logic board and flash storage
- For Mac mini (2018): Logic board

Important: Before starting this procedure, make sure the customer's current data is backed up.

Notes:

- If the serial numbers are not entered and saved in the repair system correctly, the necessary suites will not become available.
- The serial number must be entered in upper case characters. To ensure accuracy, it is recommended to scan the QR code on the logic board.

Tools:

- Power cord
- USB-C to USB-C Charge Cable included with portables (661-06670) or USB-A to USB-C Apple TV Restore Cable (923-00504)



- Customer's computer with a compatible keyboard and mouse or trackpad connected via USB (desktops only).
- A host computer with:
 - macOS Mojave 10.14 or later and the latest version of iTunes installed.
 - Mac Configuration Utility (MCU) installed. For information on how to set up the host computer, refer to [OP476: Latest Apple Service Toolkit download links and documentation](#).
 - Internet connection.

Steps:

1. Start an AST 2 diagnostic session from an iPad or other device.
2. Connect the customer's computer to the host computer. If the host computer does not have a USB-C port, use a USB-C to USB-A cable. It is important to connect the USB-C cable to the correct port or the process will not run.
 - For notebooks: Use only the USB-C port closest to the caps lock key.



- For iMac Pro: Use only the USB-C port closest to the Ethernet port.



- For Mac mini (2018): Use only the USB-C port closest to the HDMI port.



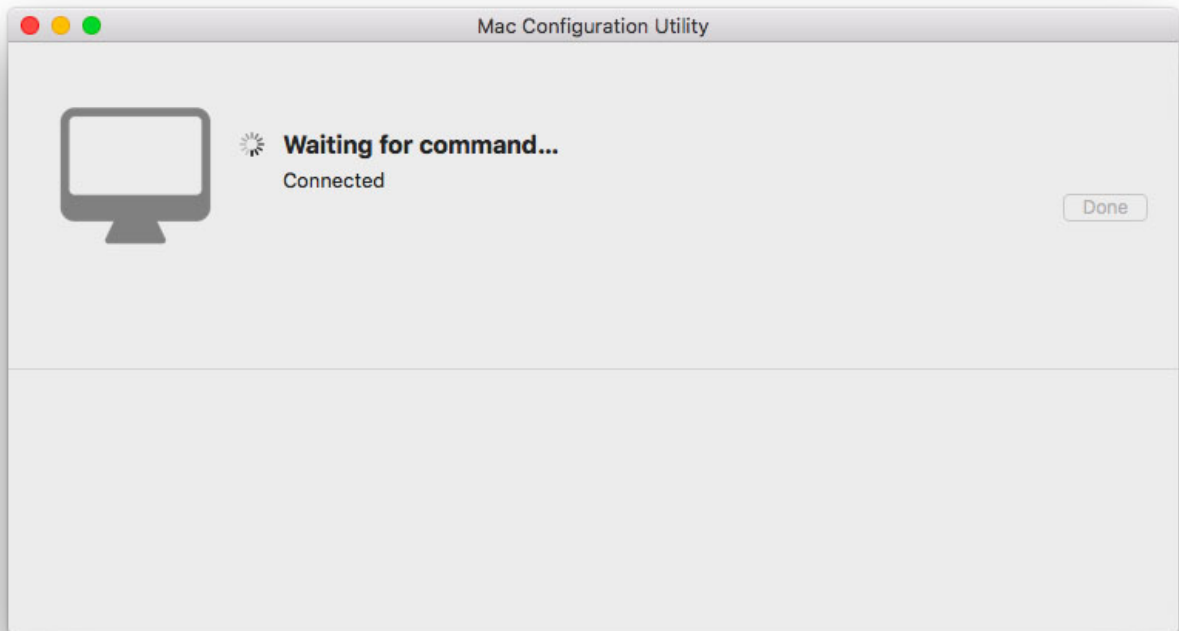
3. Verify that the host computer is turned on, connected to power, and connected to the Internet.

4. Start up the customer's computer in DFU mode.

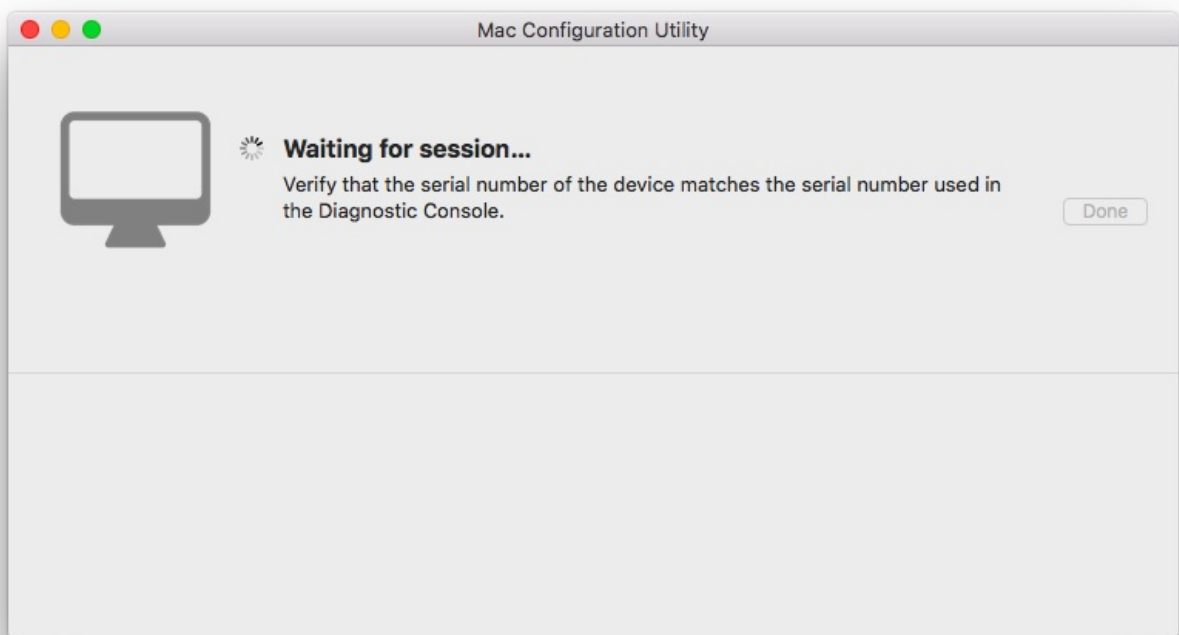
- For desktops: Press and hold the power button on the rear enclosure and connect the power cord. Continue to hold the power button until you see the device appear in Mac Configuration Utility, which may take up to 10 seconds.
- For notebooks: Press and hold the power button, then press and hold Left Control-Left Option-Right Shift until you see the device appear in Mac Configuration Utility, which may take up to 10 seconds.



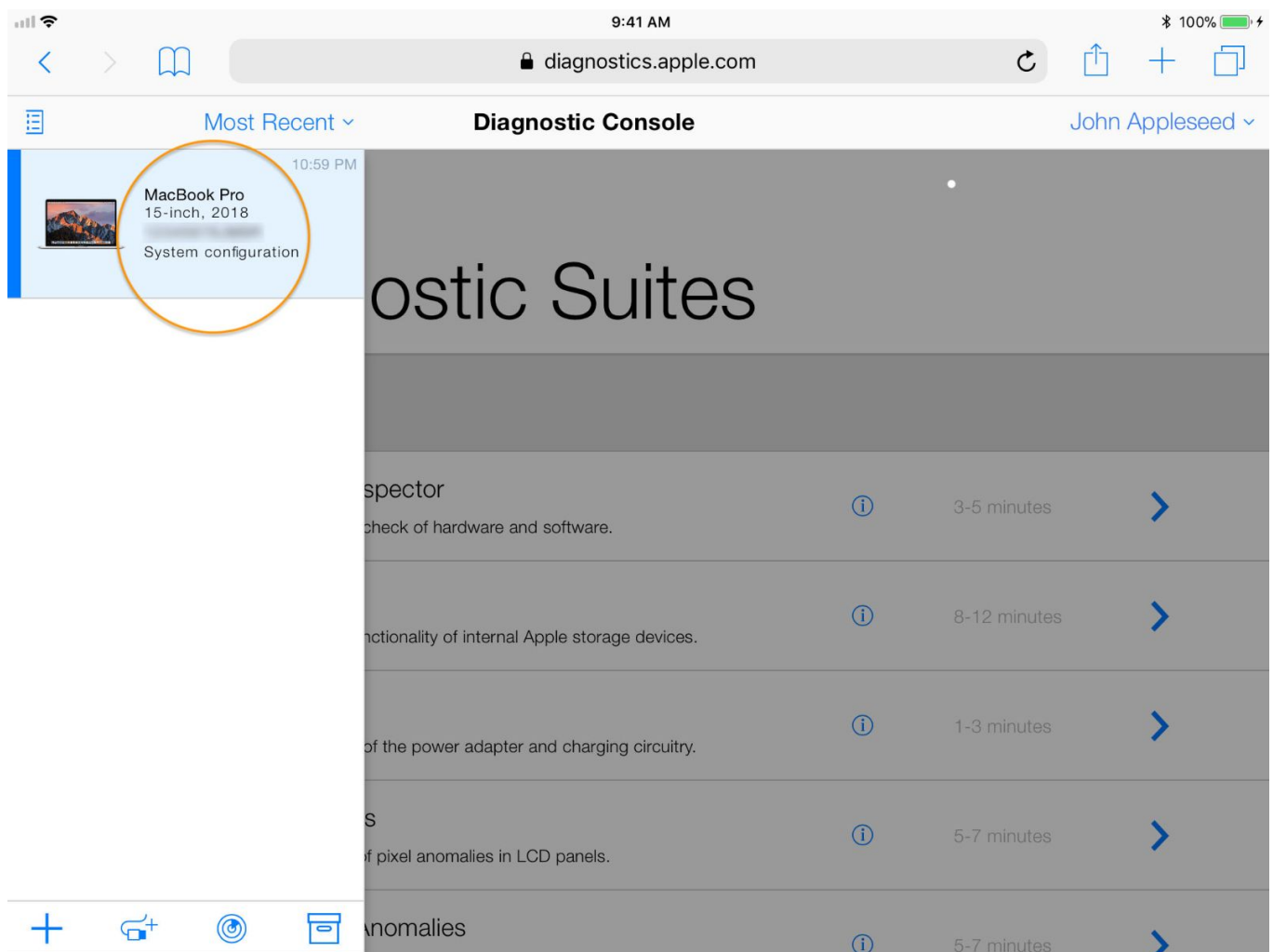
5. MCU will automatically launch and a dialog box will appear on the host computer screen.



Note: If a diagnostic session has not been created yet, this message will appear:



6. Confirm that the customer's computer appears online in the Diagnostic Console. **Note:** If the computer does not appear, the serial number may have been entered incorrectly or the repair was not saved correctly. Both the system serial number and the part serial numbers must be accurate to continue.



7. Choose the System Configuration suite from the Diagnostic Console. **Note:** While the process is running, the customer's display remains blank most of this time. Firmware restoration will take about five minutes.







9:41 AM 100%

diagnostics.apple.com







Diagnostic Console John Appleseed

Diagnostic Suites

POST-REPAIR

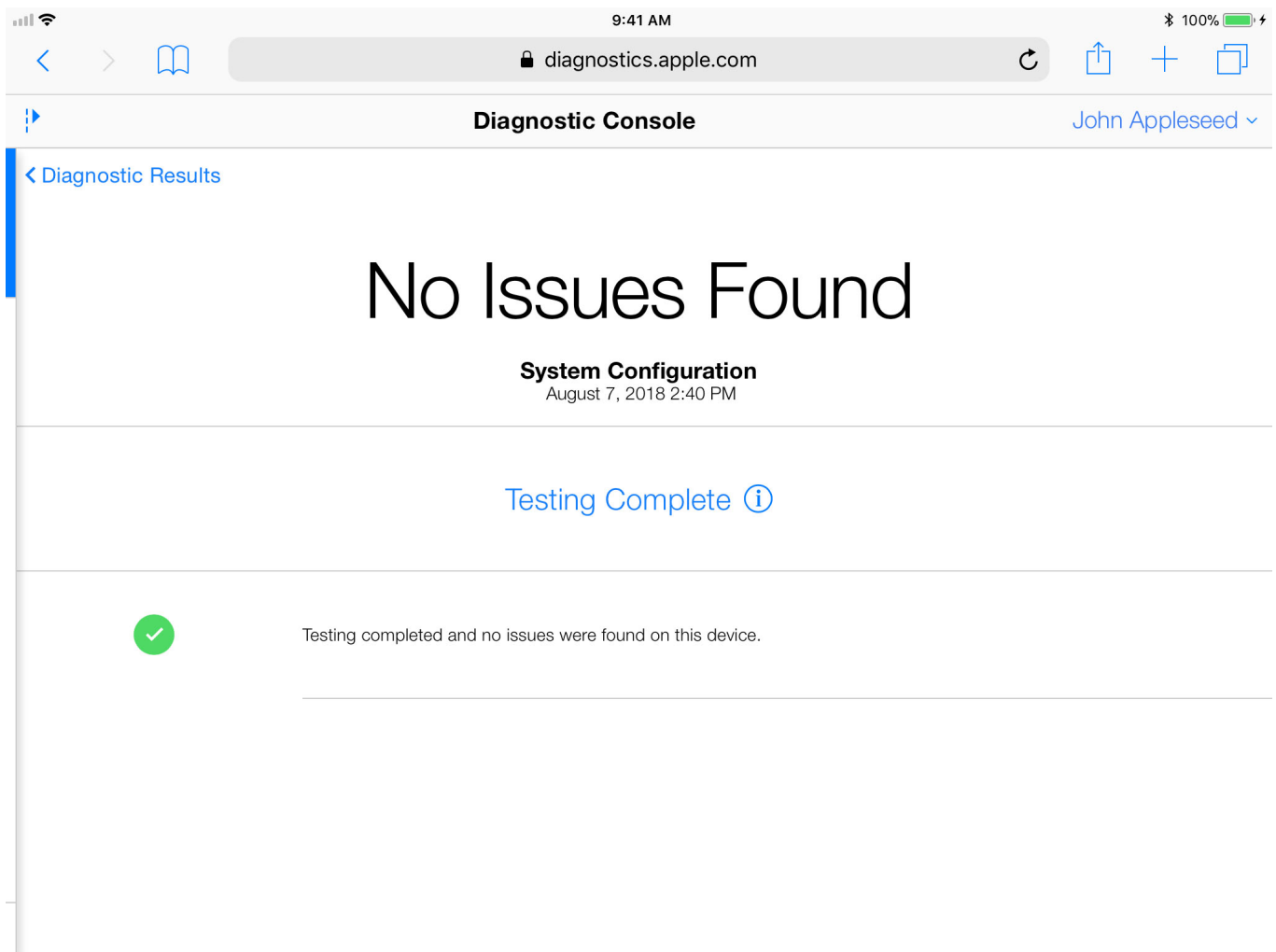
	Full System Diagnostic (EFI) Performs comprehensive testing of hardware functionality and memory module integrity.		30-90 minutes	
	Full System Diagnostic (OS) Performs comprehensive testing of hardware and graphics functionality.		15-30 minutes	

REPAIR COMPLETION

	System Configuration Completes required configuration of applicable service parts and updates firmware after repair. This suite becomes available after service part serial numbers are saved in a repair. For more information refer to TP1657: System Configuration.		1-10 minutes	
	Trackpad Calibration Check Verifies calibration of the trackpad actuator and force sensor. This suite must be run each time the computer is opened and reassembled.		3-7 minutes	

8. Toward the end of the process, the Apple logo and a progress bar will appear.

9. The customer's computer will restart and test results will appear in the Diagnostic Console of AST 2.



10. If no issues found, restart the customer's computer and run MRI and all applicable diagnostics to complete the repair.

Note: For notebooks, macOS does not need to be reinstalled. For desktops, macOS does need to be reinstalled. Shut down the desktop and then restart in recovery mode to install the macOS from Internet Recovery. Internet speeds may adversely impact the ability to restore from Internet Recovery.

11. If issues found:

- Confirm that all setup steps were followed correctly. For information on how to set up the host computer, refer to [OP476: Latest Apple Service Toolkit download links and documentation](#).
- Confirm that serial numbers for all parts, both new and old, were saved correctly into the repair system.
- Archive the AST 2 session, create a new one, and rerun the System Configuration suite.
- Quit and relaunch MCU. If unsuccessful, reboot the host computer.
- Rerun the suite.

Troubleshooting Tips:

If the System Configuration suite is unavailable, check the following:

1. Verify that the new and old service part serial numbers were entered correctly for all parts used and saved into the repair system.
2. Verify that the correct serial number of the customer's computer was entered into the Diagnostic Console.
3. Verify that the serial number of the customer's computer was used to create the repair.
4. Verify that the device is correctly connected to the host Mac and that Mac Configuration Utility is running.
5. A correctly connected device will show as "Apple Mobile Device (DFU Mode)" in System Information > USB.
6. Do not use USB-C to USB-A cable (923-00504) combined with USB-C to USB Adapter (MJ1M2AM/A).

If the device goes offline while running System Configuration or the suite does not complete, check the following:

1. Archive the AST 2 session, create a new one, and rerun the System Configuration suite.
2. Restart the host Mac.
3. Open the device and confirm that all internal components were properly installed.
4. Check for system outages.

Data Transfer for Macs with the Apple T2 Security Chip

Desktops and notebooks that have the Apple T2 Security Chip include security features that require a specific process for transferring data. Data from a damaged logic board can sometimes be captured and transferred before any service.

Important:

- This process will leave the customer system in a recovery state that makes the system appear unresponsive. To recover the system following data transfer, perform a restore using Apple Configurator 2. For more information on Apple Configurator 2 refer to [Restore Apple desktop computers that have the Apple T2 Security Chip](#) and [Restore Apple portable computers that have the Apple T2 Security Chip](#).
- Files and folders cannot be modified or deleted from the customer computer volumes. Those volumes are intended to be read only.
- After the transfer process, some files such as .bin, .etc, .tmp, and .usr may be visible on the external hard drive. This is expected behavior. Do not delete or modify these files or folders as doing so may cause issues for the customer when they migrate information from the external hard drive back to the customer's computer.
- It can take 10–20 minutes for the external hard drive to be partitioned.
- When transfer is complete, return the hard drive with the customer's data to the customer. Explain how they can migrate their data back to their computer using migration assistant.

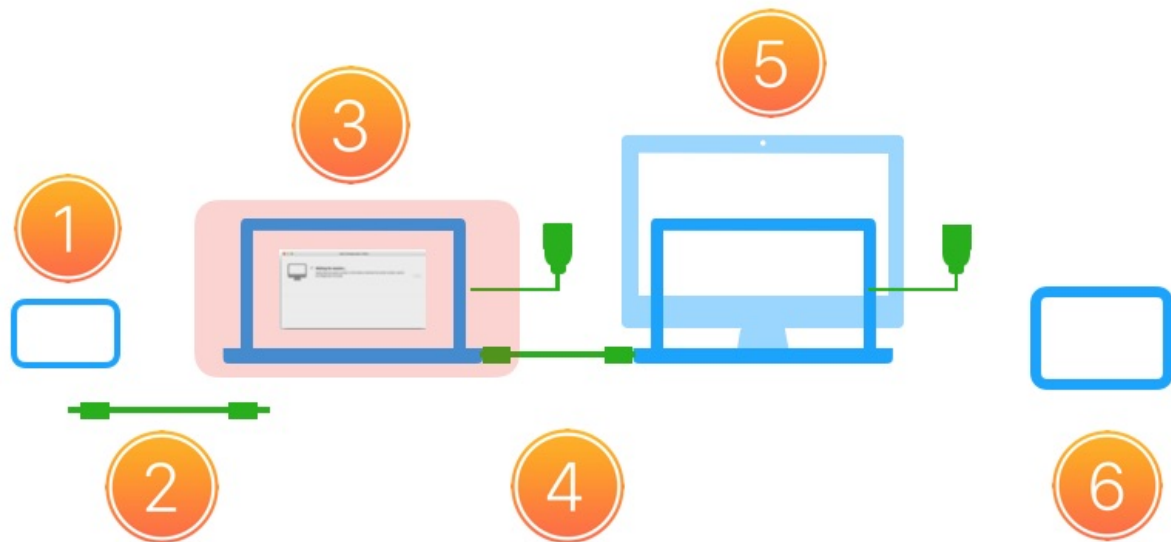
For video instruction, refer to [SV373: Macs with the Apple T2 Security Chip: Data Transfer to an External Hard Drive](#).

Tools:

- Power cord
- USB-C to USB-C Charge Cable included with portables (661-06670) or USB-A to USB-C Apple TV Restore Cable (923-00504)



- Customer's computer with a compatible keyboard and mouse or trackpad connected via USB (desktops only).
- A host computer with:
 - macOS Mojave 10.14 or later and the latest version of iTunes installed.
 - Mac Configuration Utility (MCU) installed. For information on how to set up the host computer, refer to [OP476: Latest Apple Service Toolkit download links and documentation](#).
 - Internet connection.
- An external hard drive of equal or greater capacity than the installed system storage. **Note:** The hard drive will be configured and password protected with the customer's computer serial number during the process.
- iPad or other device used to create an Apple Service Toolkit 2 (AST 2) diagnostic session.



1. External hard drive
2. External hard drive cable
3. Host computer
4. Thunderbolt 3 (USB-C) to Thunderbolt 3 (USB-C) or Thunderbolt 3 (USB-C) to USB-A cable
5. Customer's computer (Apple T2 Security Chip-based desktop or notebook)
6. iPad or other device running AST 2 with access to GSX

Steps:

1. Verify that part 076-00399 Data Transfer Setup (Retail) or 076-00410 Data Transfer Setup - Transaction Only (ASP) has been added to the repair and saved.
2. Launch the Diagnostic Console (diagnostics.apple.com) and start an AST 2 diagnostic session using the customer computer serial number.
3. Connect the customer's computer to the host computer. If the host computer does not have a USB-C port, use a USB-C to USB-A cable. It is important to connect the USB-C cable to the correct port or the process will not run.
 - For notebooks: Use only the USB-C port closest to the caps lock key.



- For iMac Pro: Use only the USB-C port closest to the Ethernet port.



- For Mac mini (2018): Use only the USB-C port closest to the HDMI port.



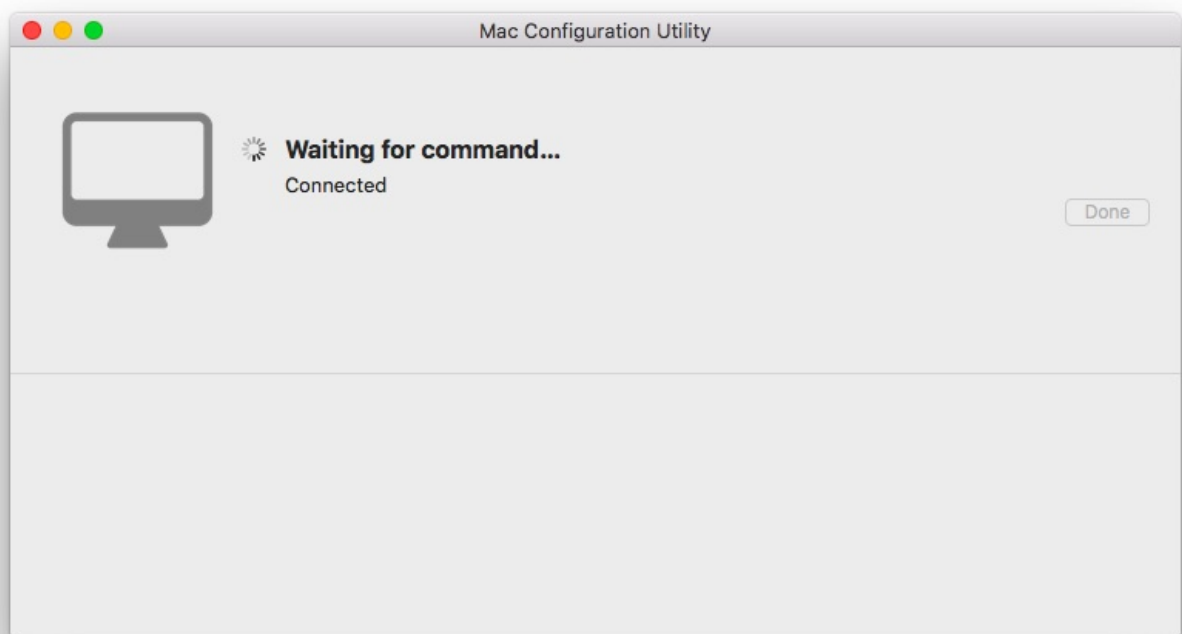
4. Verify that the host computer is turned on, connected to power, and connected to the Internet.

5. Start up the customer's computer in DFU mode.

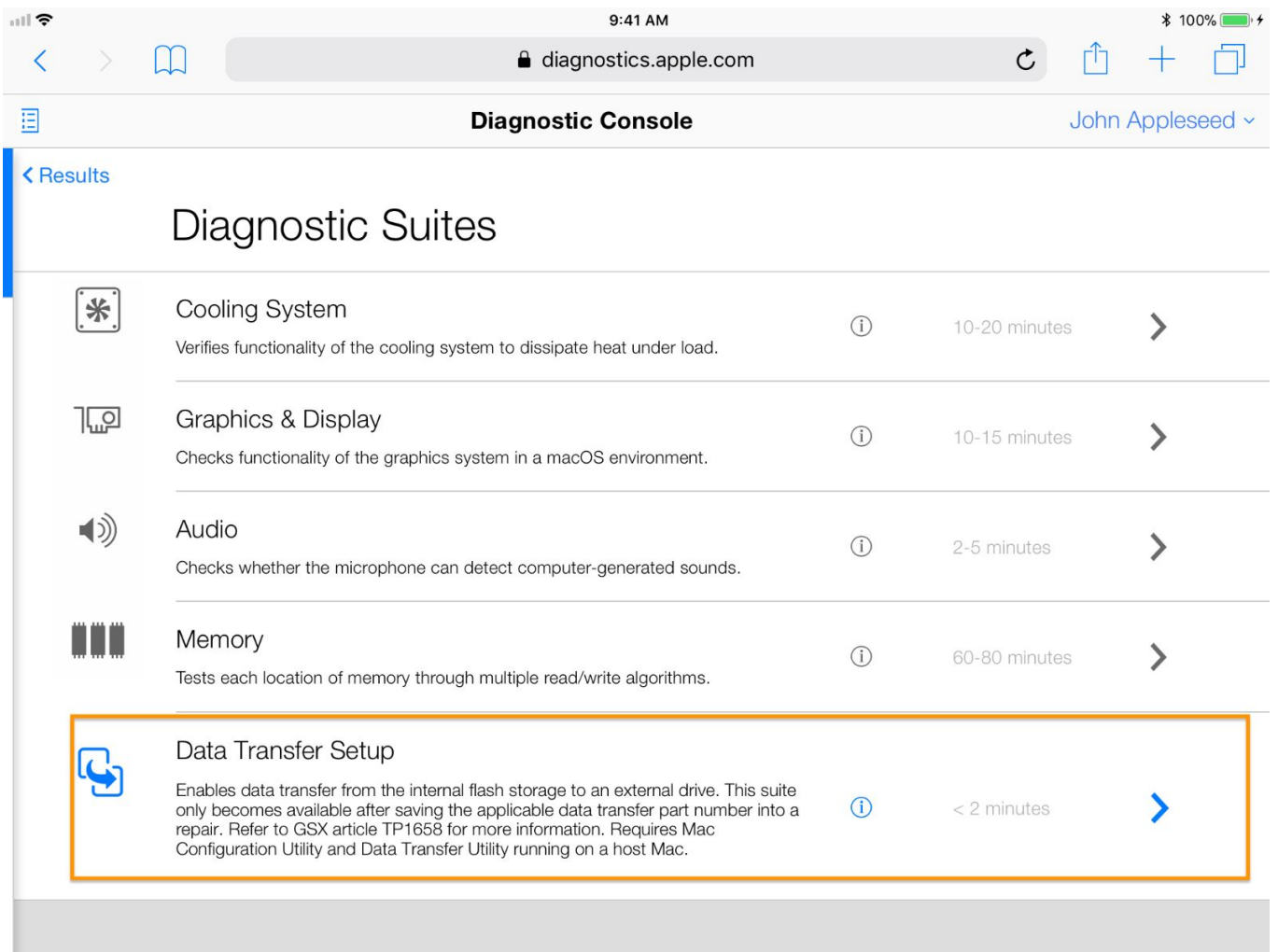
- For desktops: Press and hold the power button on the rear enclosure and connect the power cord. Continue to hold the power button until you see the device appear in Mac Configuration Utility, which may take up to 10 seconds.
- For notebooks: Press and hold the power button, then press and hold Left Control-Left Option-Right Shift until you see the device appear in Mac Configuration Utility, which may take up to 10 seconds.



6. MCU will automatically launch and a dialog box will appear on the host computer screen.



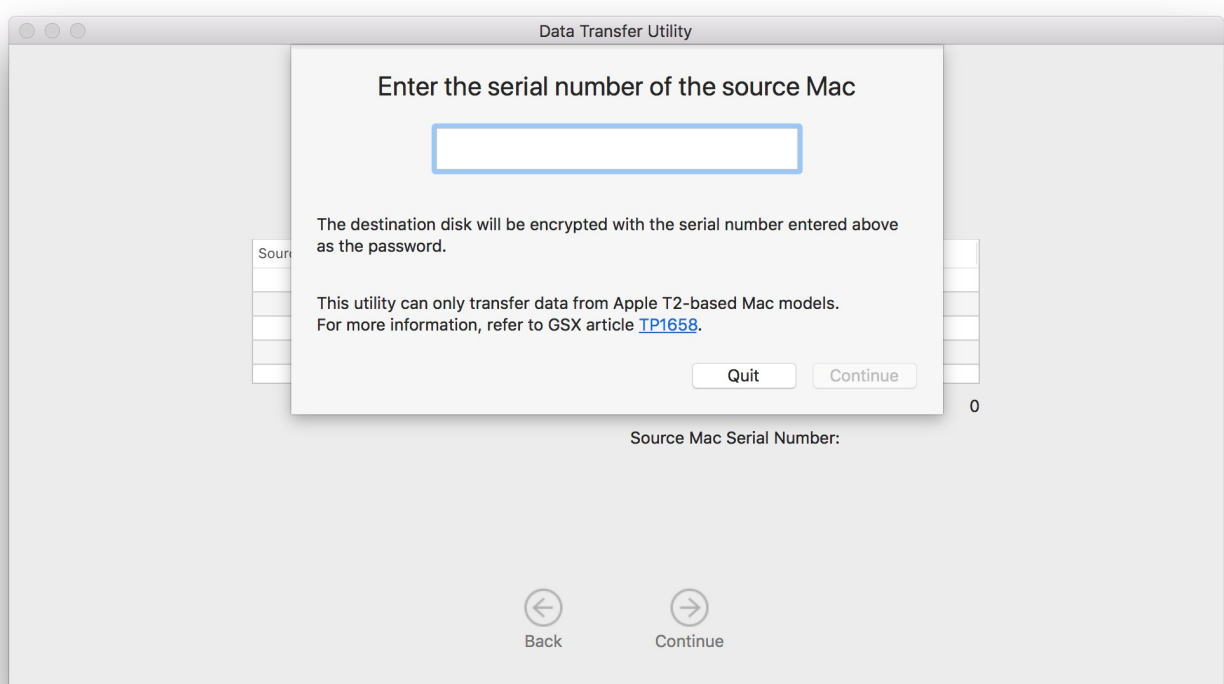
7. From the list of diagnostic suites in the Diagnostic Console, select Data Transfer Setup.



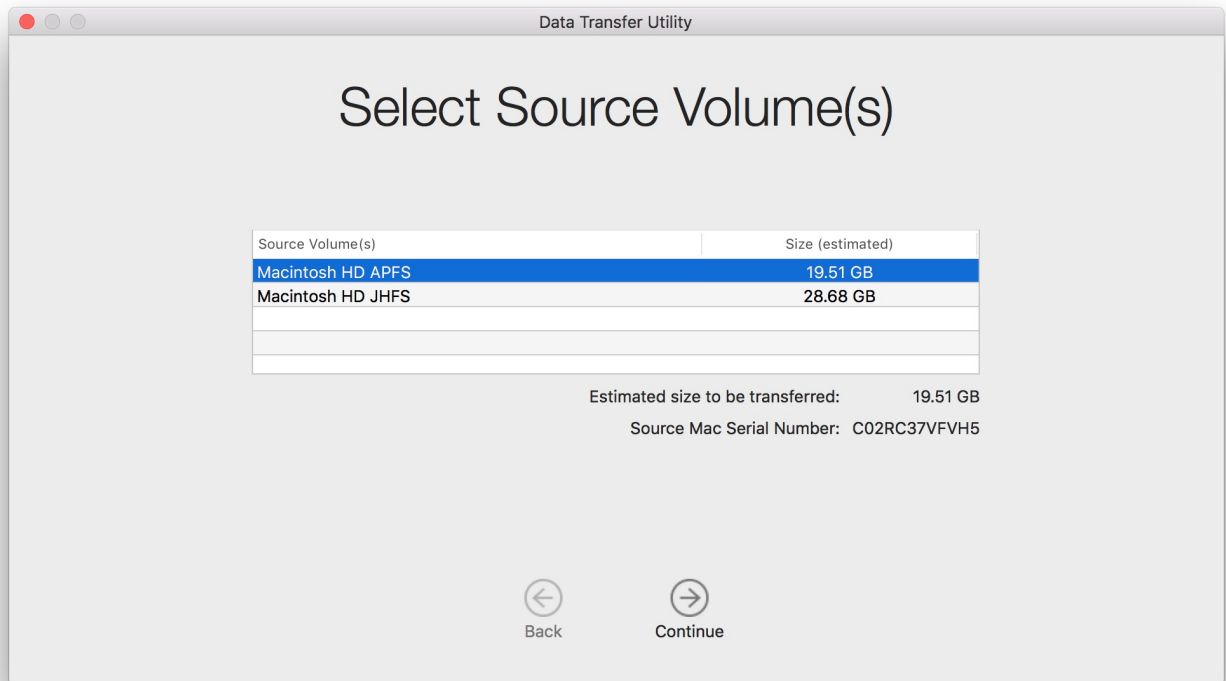
Note:

- If the customer has file vault enabled, you will be prompted to enter the password.
- The customer's computer will not display anything on the screen to indicate status. The only observable indication will be when the drive mounts as an external volume on the host Mac running MCU.

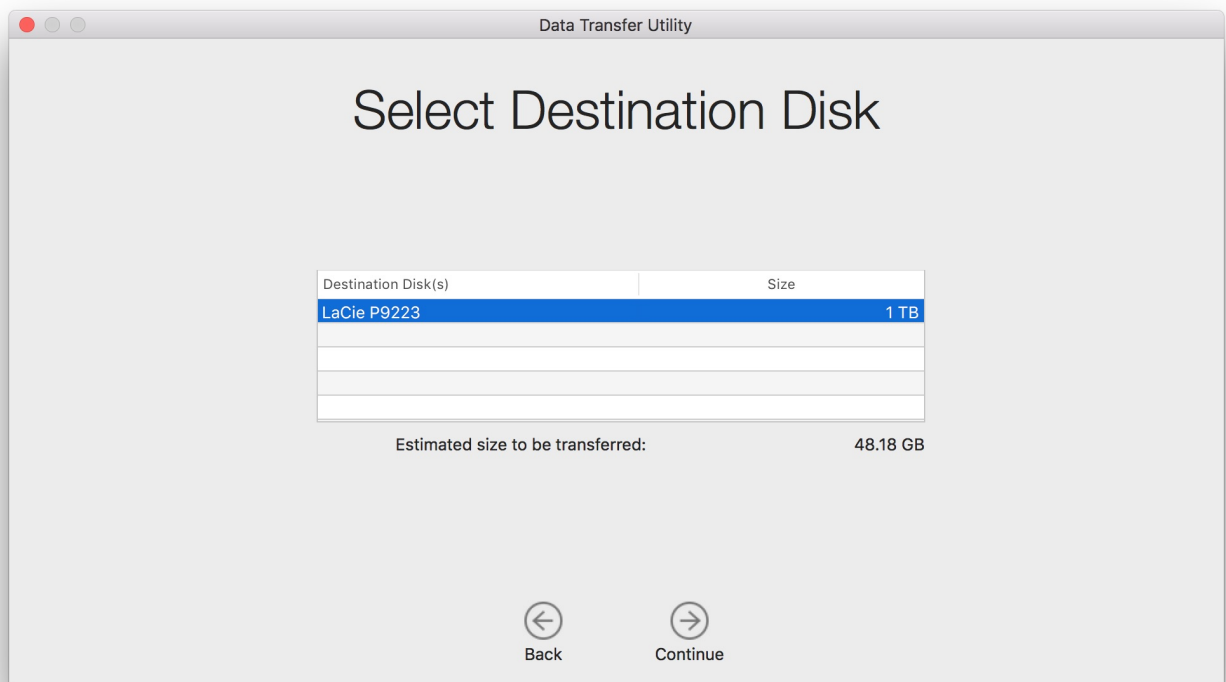
8. Open the Data Transfer Utility app on the host machine and enter the serial number of the customer's computer.



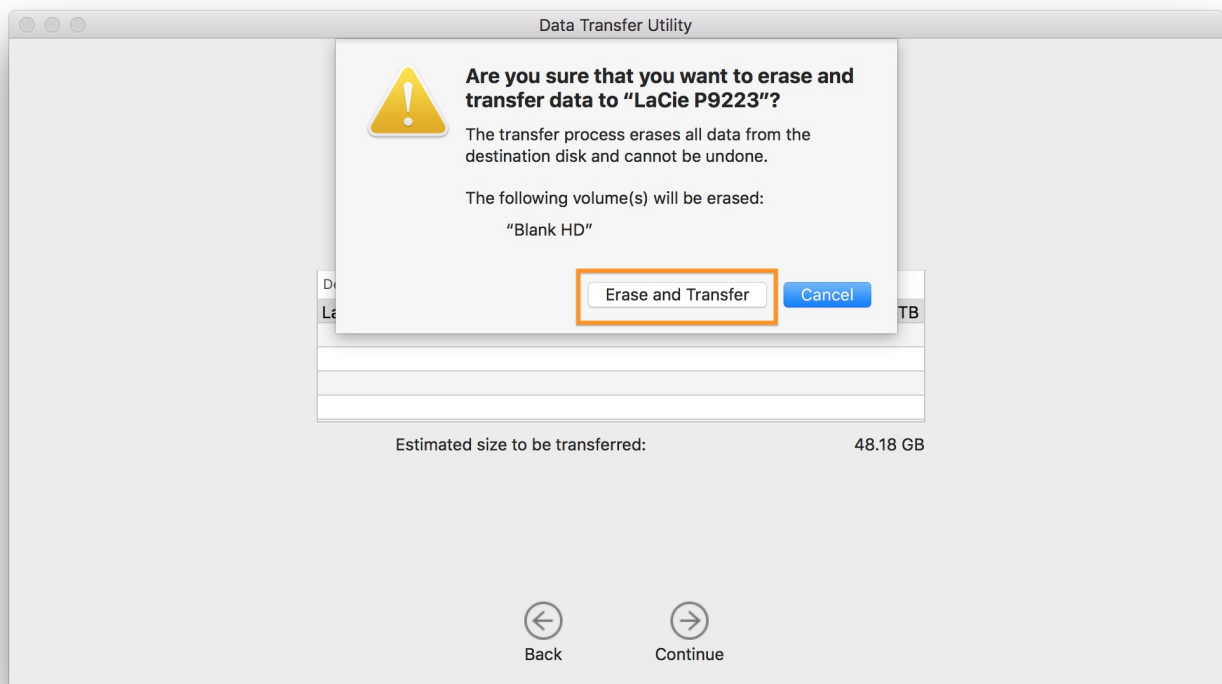
9. Select the source volume(s) and click Continue. **Note:** If more than one source volume is available, multiple volumes can be selected to be transferred.



10. Connect an external hard drive to the host machine. Select the destination, and click Continue.



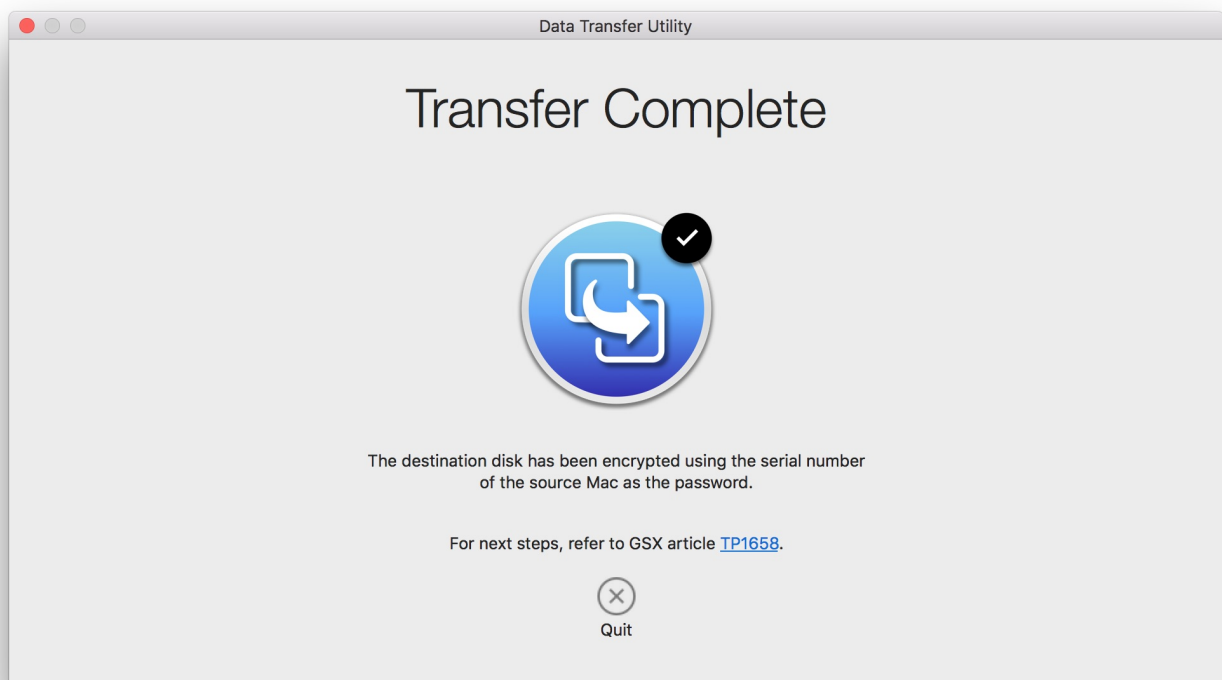
11. Click Erase and Transfer.



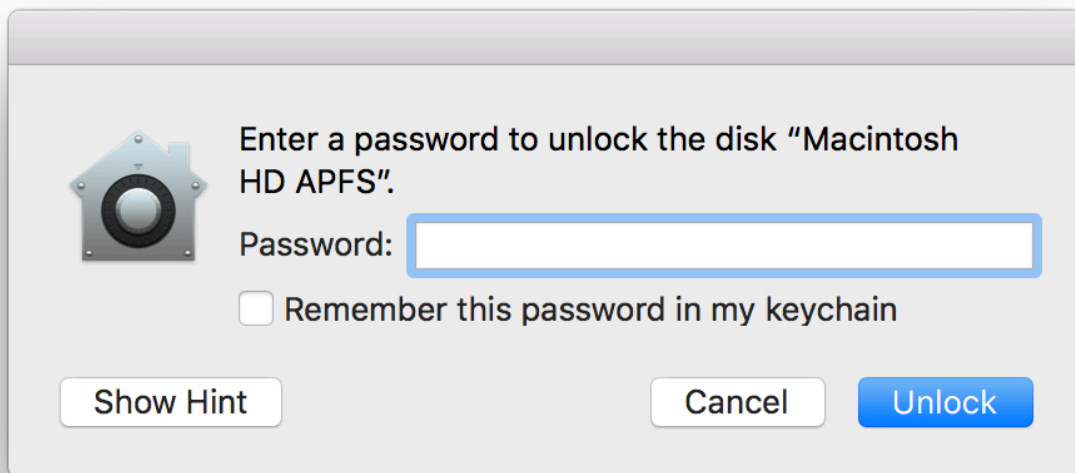
Important: The length of time required to complete this process depends on how much data is on the drive. This process could take up to two days.

12. Transfer complete.

Important: Check the transfer is successful before closing the repair. Once the repair is closed this procedure cannot be performed again on the KBB logic board.



13. Make sure the external drive is encrypted and the password works by unplugging it and plugging it back in.



14. Once the repair is closed, data transfer using this process is no longer possible.

Troubleshooting Tips:

If the Data Transfer Setup suite is unavailable, check the following:

1. Verify that the correct data migration part number has been added to the repair and saved.
2. Verify that the repair that includes the logic board has not been closed.
3. Verify that the correct serial number of the customer's computer was entered into the Diagnostic Console.
4. Verify that the serial number of the customer's computer was used to create the repair.
5. Verify that the device is correctly connected to the host Mac and that Mac Configuration Utility is running.
6. A correctly connected device will show as "Apple Mobile Device (DFU Mode)" in System Information > USB.
7. Do not use USB-C to USB-A cable (923-00504) combined with USB-C to USB Adapter (MJ1M2AM/A).

If the device does not complete the Data Transfer Setup suite, check the following:

1. Archive the AST 2 session, create a new one, and re-run the Data Transfer Setup suite.
2. Restart the host Mac.

If the Data Transfer Utility app does not show any volumes under Select Source Volume(s), check the following:

1. Verify volume(s) appear in Finder or Disk Utility.
2. Verify the correct serial number of the customer's computer was entered into the Data Transfer Utility app.

If the external hard drive is not being recognized by the Data Transfer Utility app, it may need to be initialized using Disk Utility.

Reinstalling Software That Came with the Computer

Reinstalling Software That Came with the Computer

This procedure requires an Internet connection.

Note: In some situations, a user may have set a firmware password. The user must know the firmware password in order to reinstall OS X or macOS. If the user cannot remember the password, then refer to the technician instructions in [HT204455: How to set a firmware password on your Mac](#).

Important: Apple recommends that users back up their data before any software restore procedure. Back up essential files before installing OS X or macOS. Apple is not responsible for any loss of data. For instructions on using Time Machine, refer to [HT201250: How to use Time Machine to back up or restore your Mac](#).

For instructions on reinstalling the OS, follow the steps in [HT204904: How to reinstall macOS](#).

For more information about recovery mode, refer to [HT201314: About macOS Recovery](#).

Mac mini (2018) Power Supply

First Steps



Warning:

- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Cover](#)
- [Antenna Plate](#)
- [Fan](#)
- [Logic Board](#)



Tools

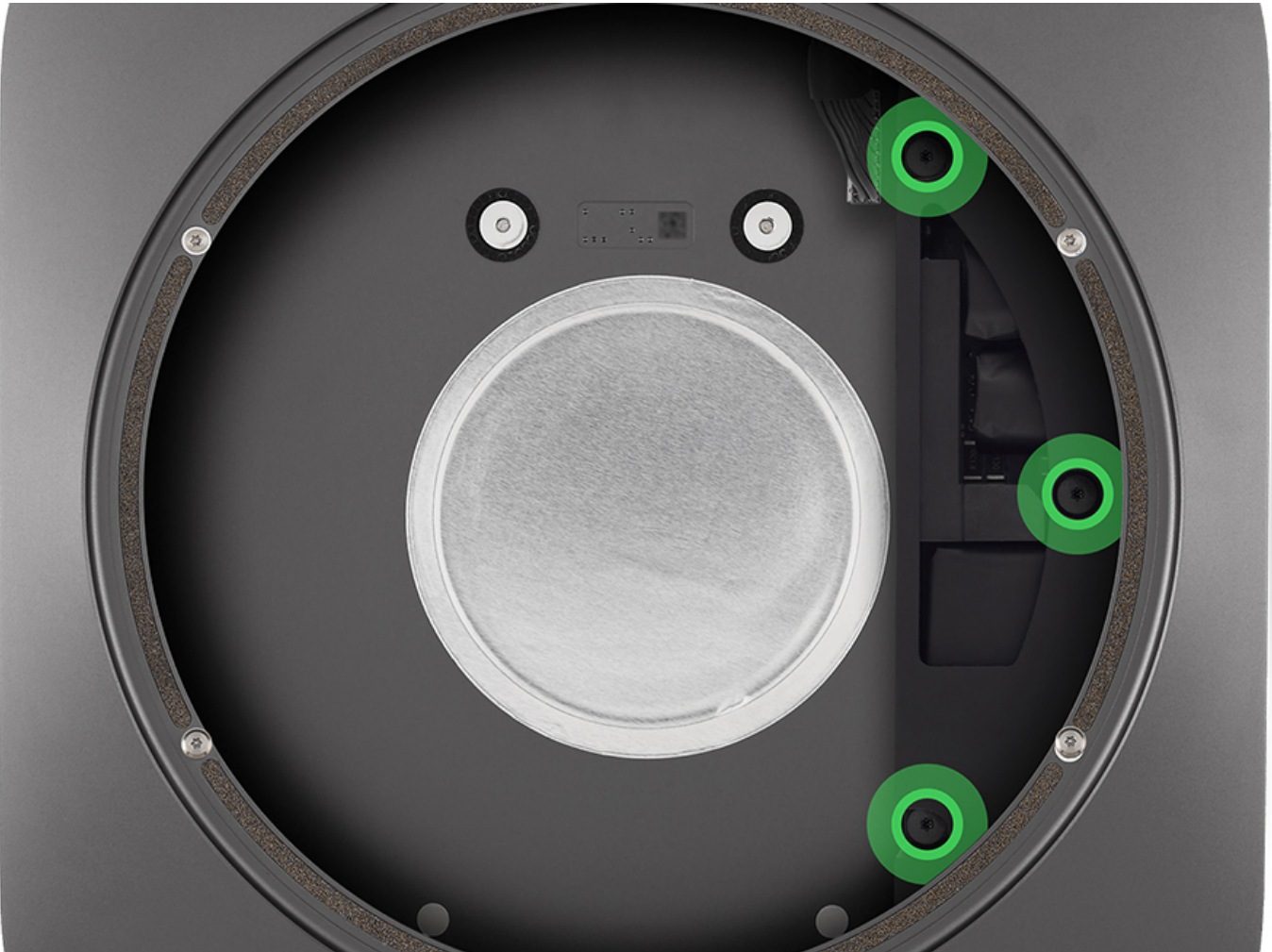
- Black stick
- Torx T6 screwdriver (magnetized)
- ESD tweezers



Steps For Removal

1. Remove the three T6 power supply screws.

- T6: 923-02796



2. Remove the AC inlet cowling (1). Use tweezers to remove the AC inlet retention clip (2). Save both for reuse.

- (1) AC inlet cowling: 923-02795



- (2) AC inlet retention clip: 923-02789





3. Rotate the AC inlet 90 degrees counterclockwise.



4. Slide the power supply out of the housing.

Note: The screw standoffs on the housing may prevent the power supply from sliding freely. If you feel resistance, angle the power supply away from the side wall as you remove it from the housing.



Steps For Reassembly

1. Slide the power supply into the housing.



2. Rotate the AC inlet 90 degrees clockwise.

Note: There are two grooves in the housing. The AC inlet rotates into the rear groove and must be aligned correctly.



3. Reinstall the AC inlet cowling and AC inlet retention clip.

- AC inlet retention clip: 923-02789



- AC inlet cowling: 923-02795



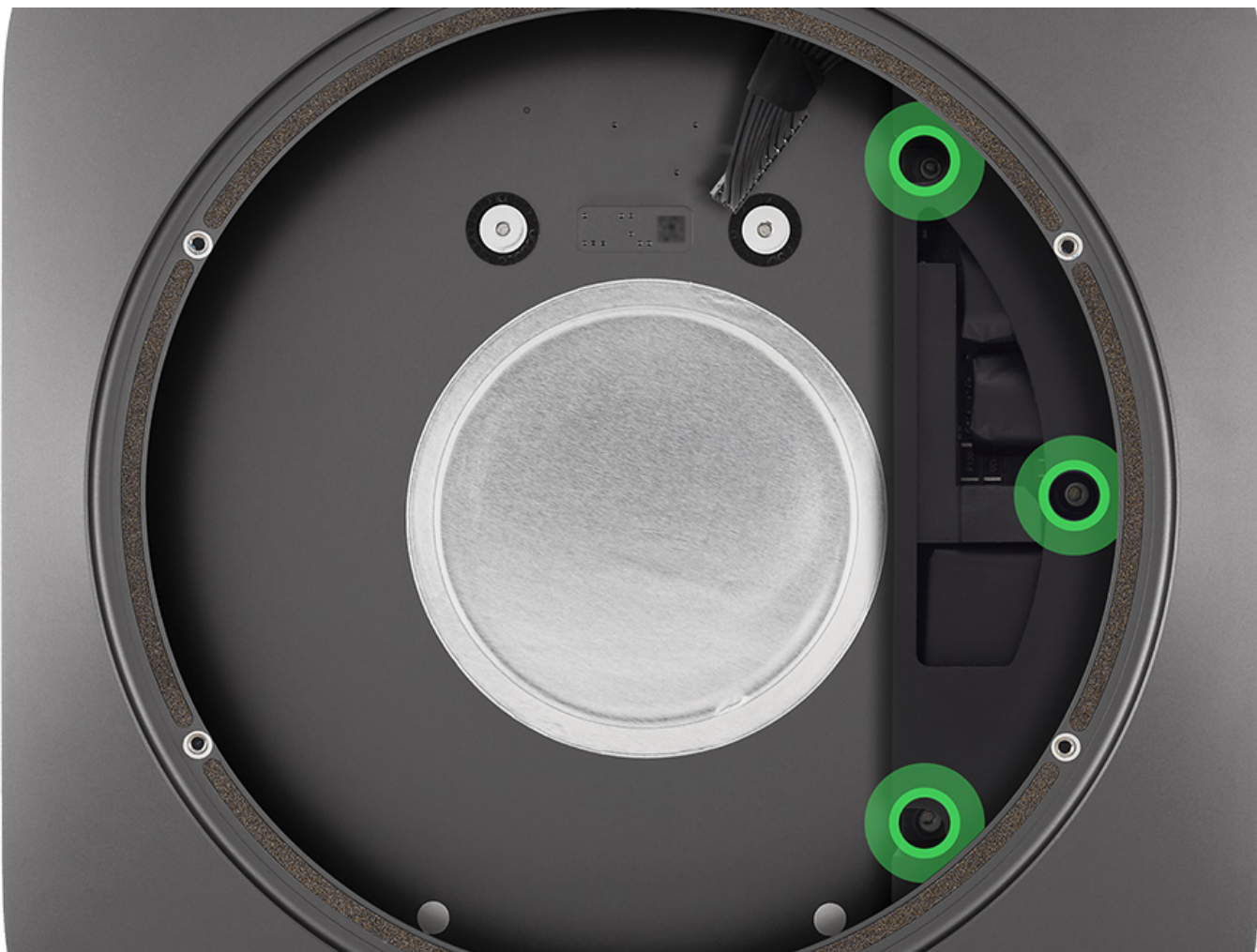
Note: There is a foam insulator inside the cowling. This should be positioned closest to the retention clip.



4. Reinstall the three T6 power supply screws.

- T6: 923-02796





5. Reinstall the [logic board](#).
6. Reinstall the [fan](#).
7. Reinstall the [antenna plate](#).
8. Reinstall the [bottom cover](#).

Mac mini (2018) Memory

First Steps



Warning:

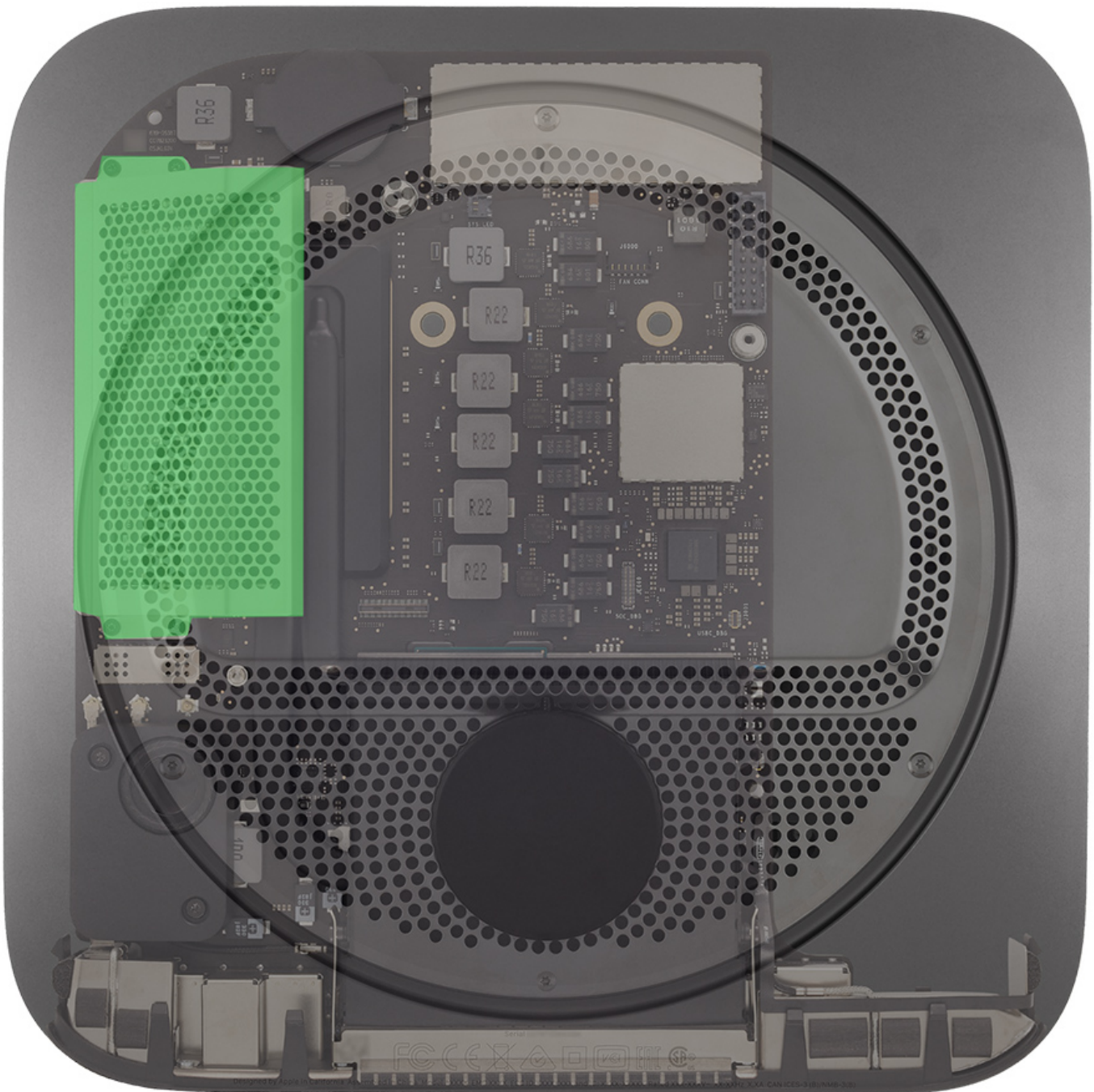
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Cover](#)
- [Antenna Plate](#)
- [Fan](#)
- [Logic Board](#)



Tools

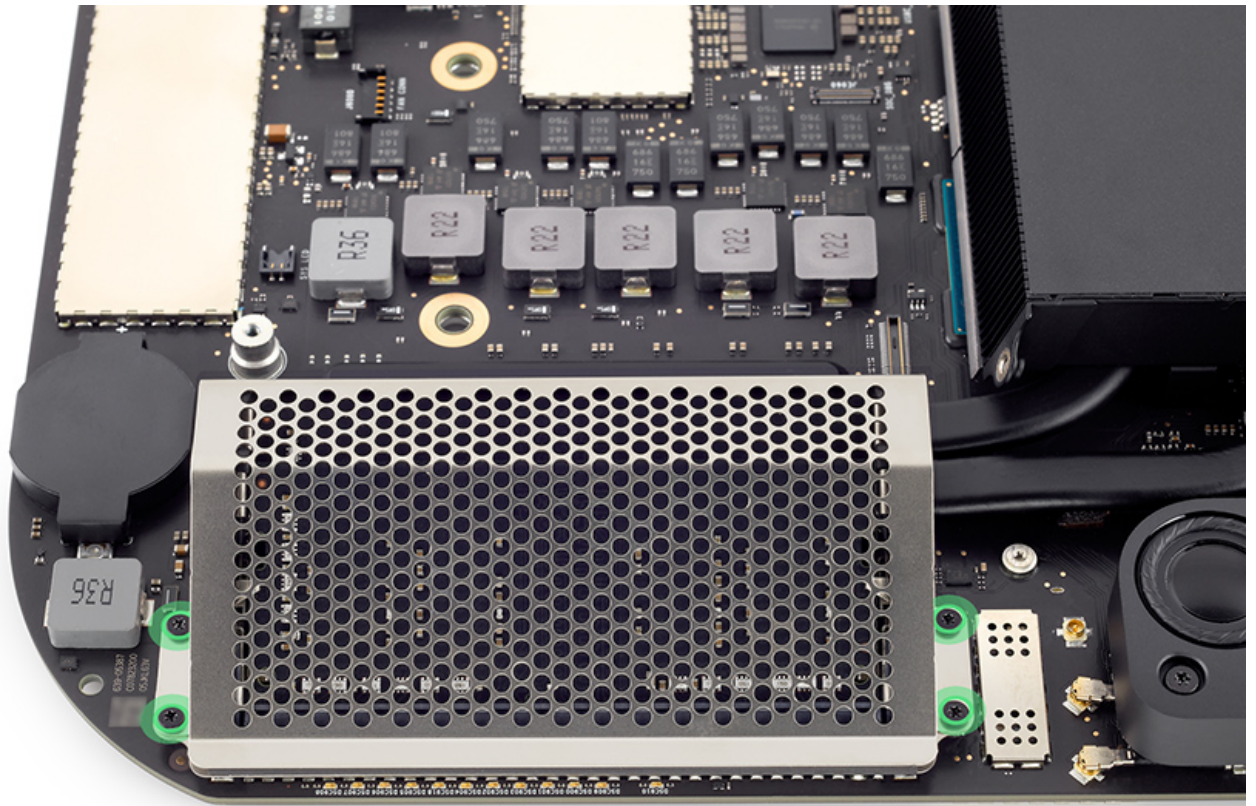
- Black stick
- Torx T5 screwdriver (magnetized)



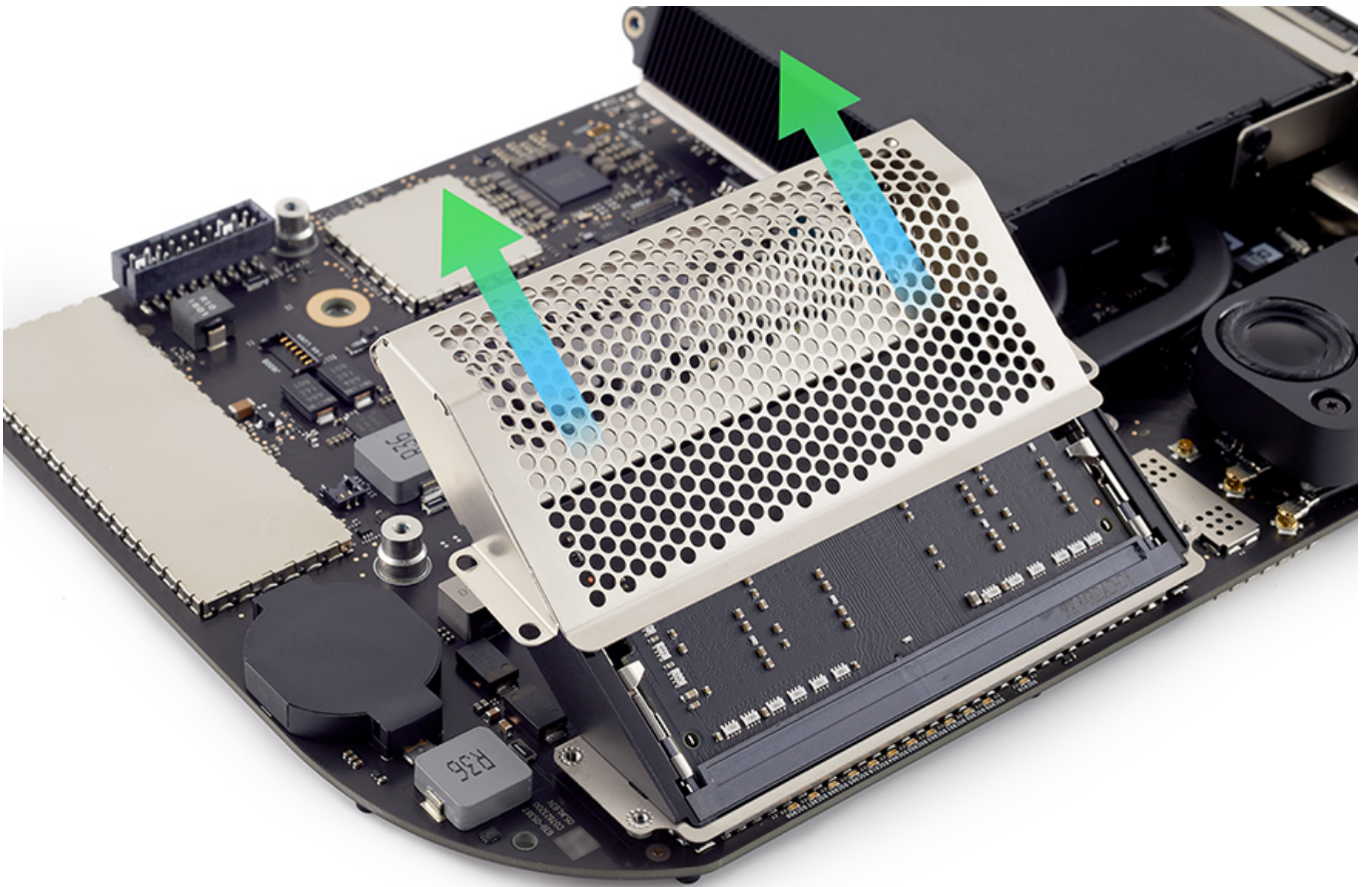
Steps For Removal

1. Remove the four T5 screws from the memory cover.

- T5: 923-02798



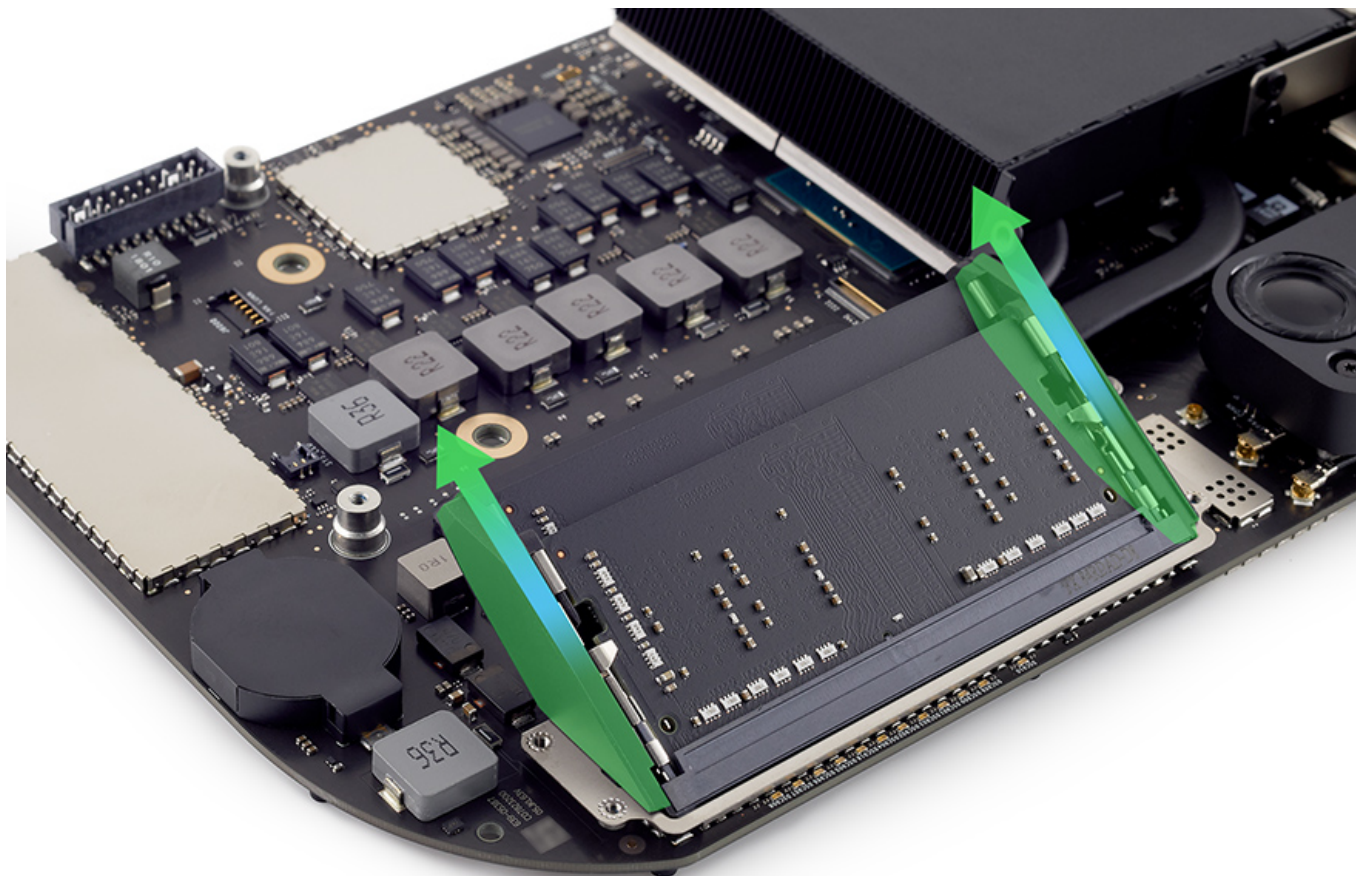
2. Slide the cover up and away from the memory.



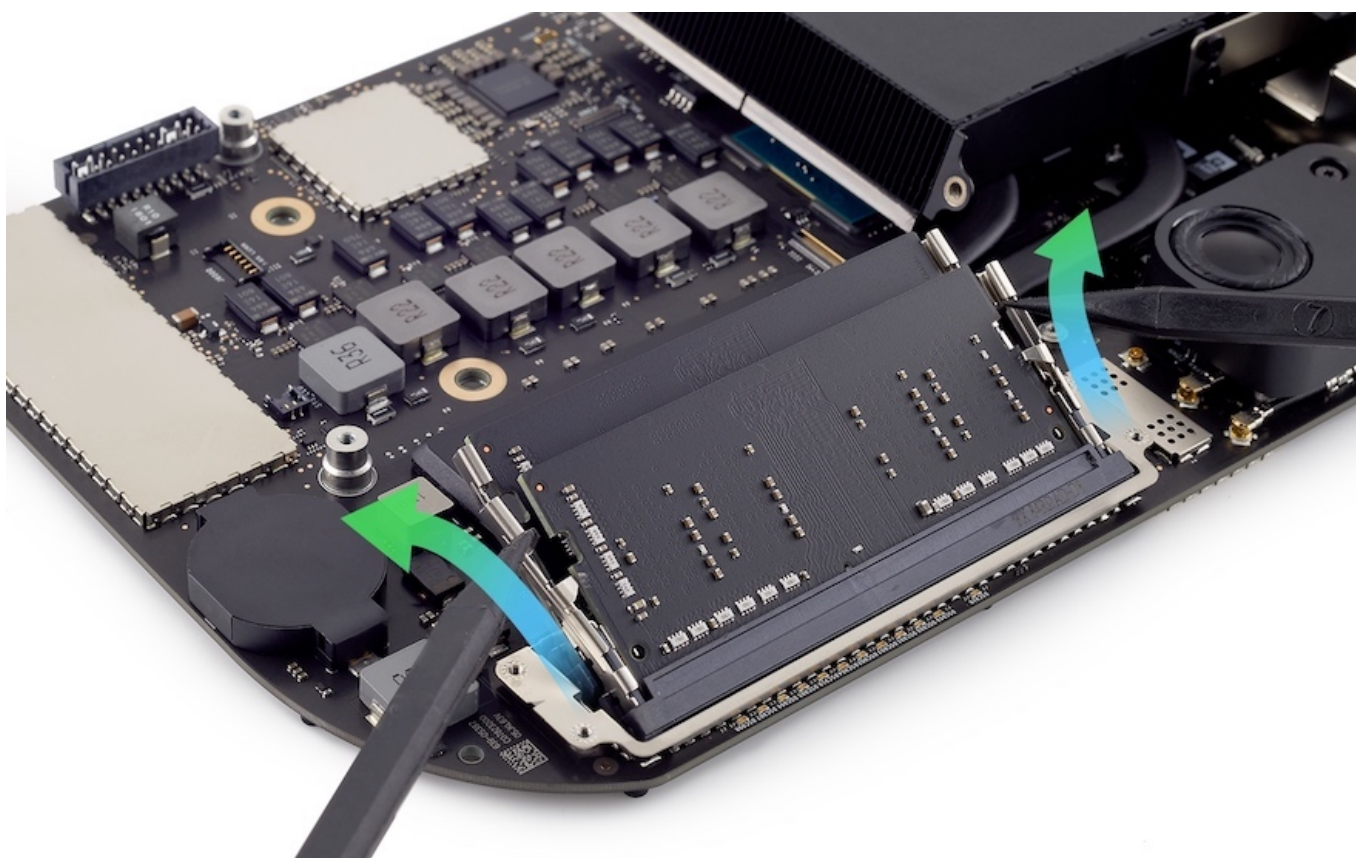
3. Remove the left and right bumpers from the memory springs.

- Left and right bumpers: 923-02792



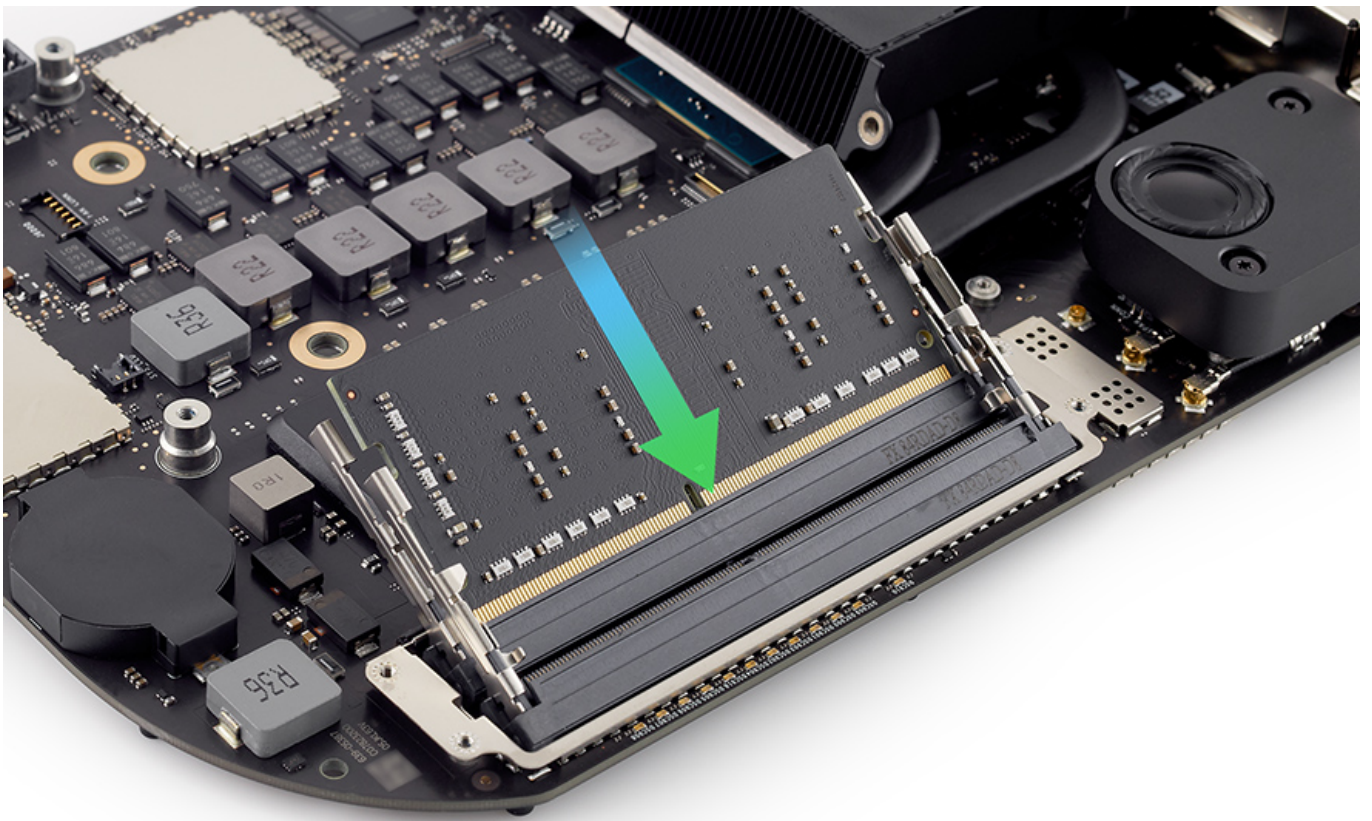


4. Push the front memory springs outward to release the front memory module. Repeat the process on the rear memory springs to release the rear memory module.
Note: Always handle memory by the edges.

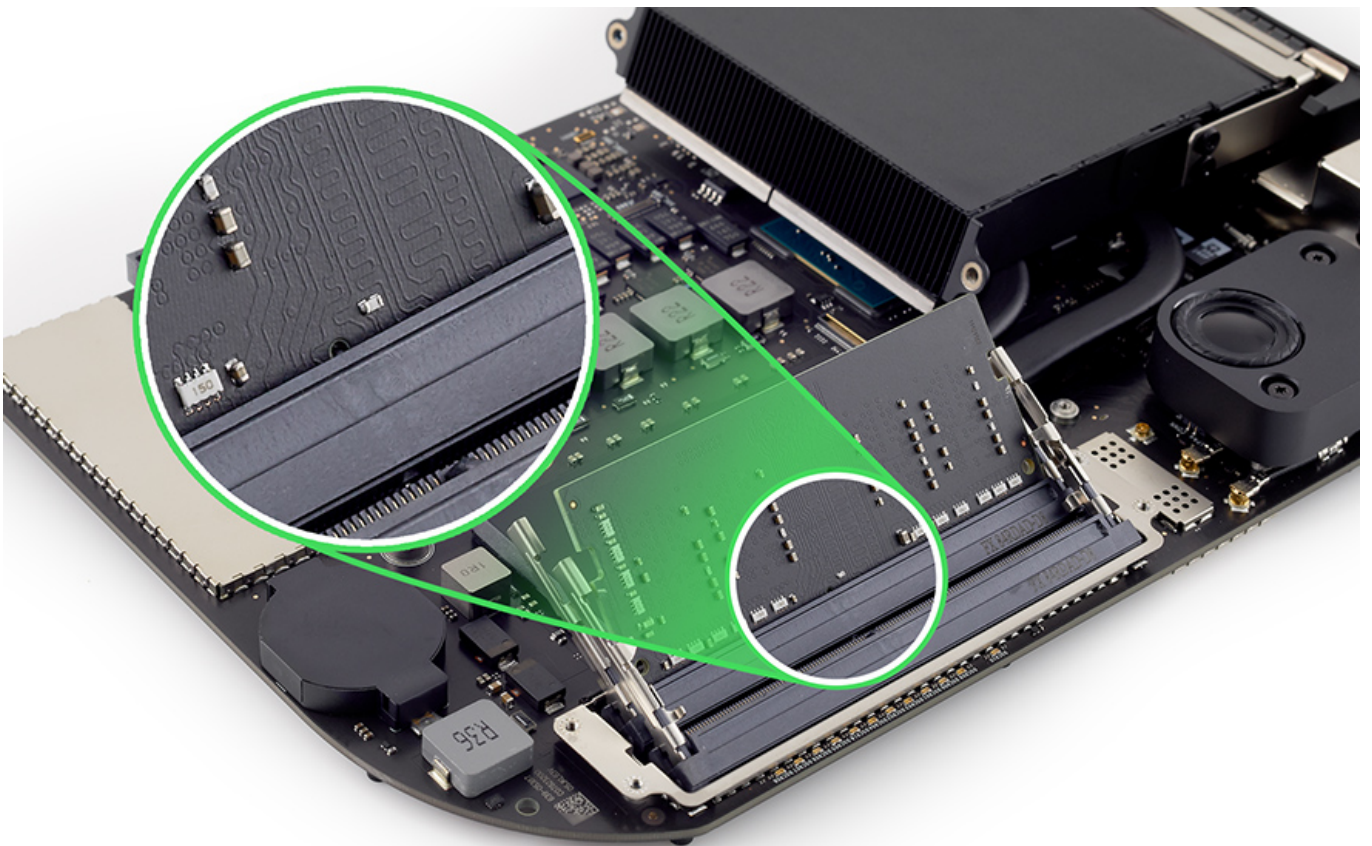


Steps For Reassembly

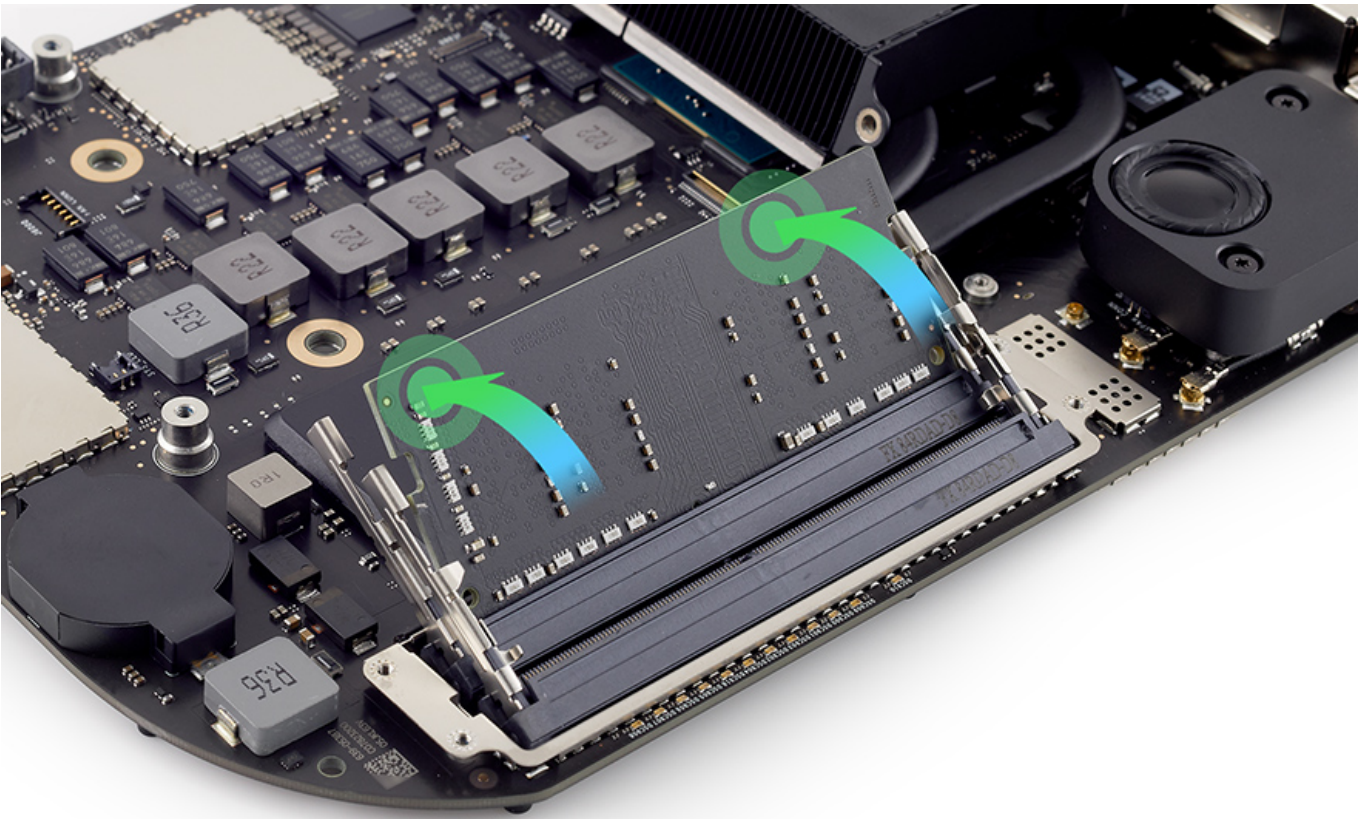
1. Insert one memory module into the rear memory slot.



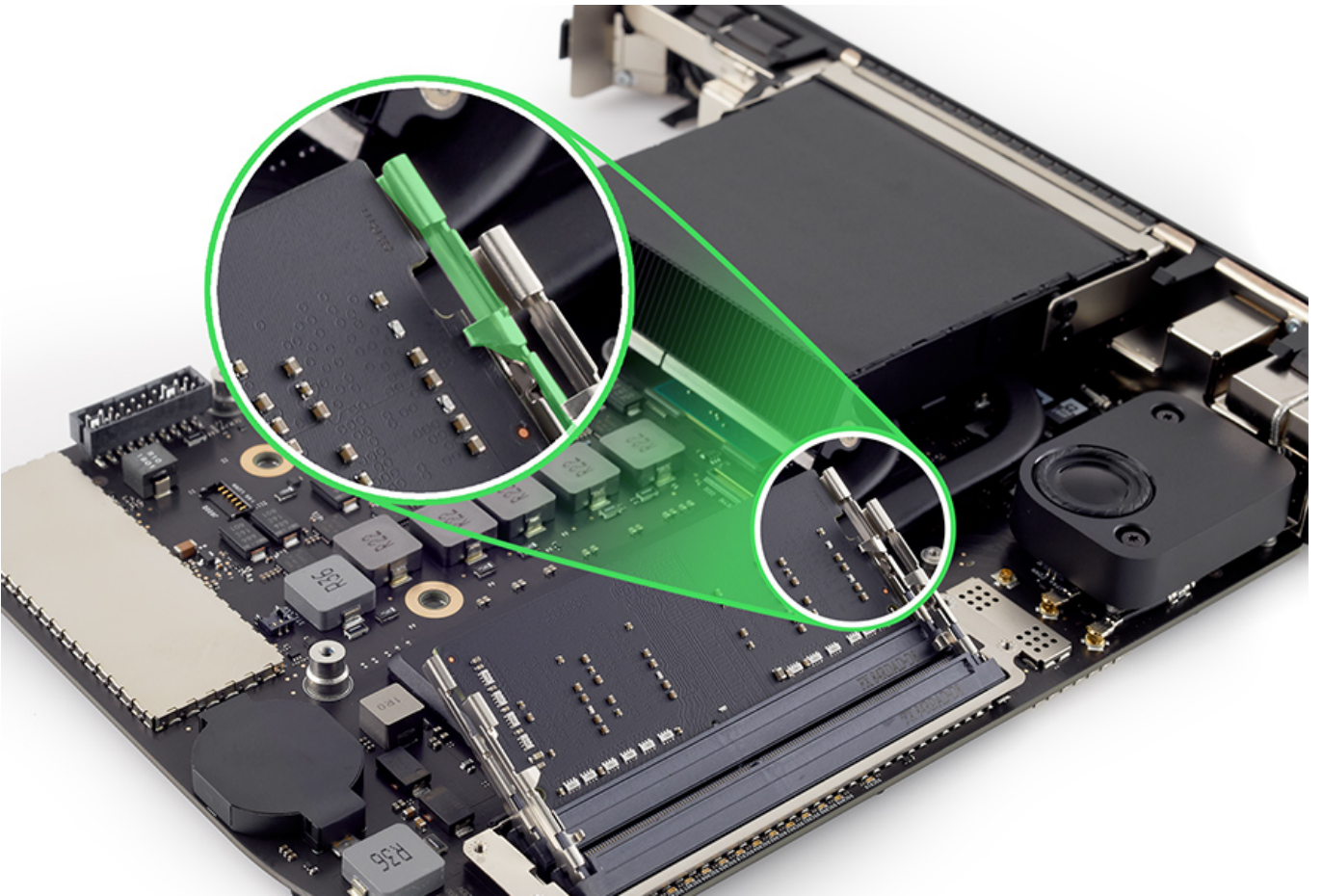
2. Verify the contact pins sit below the edge of the memory slot.



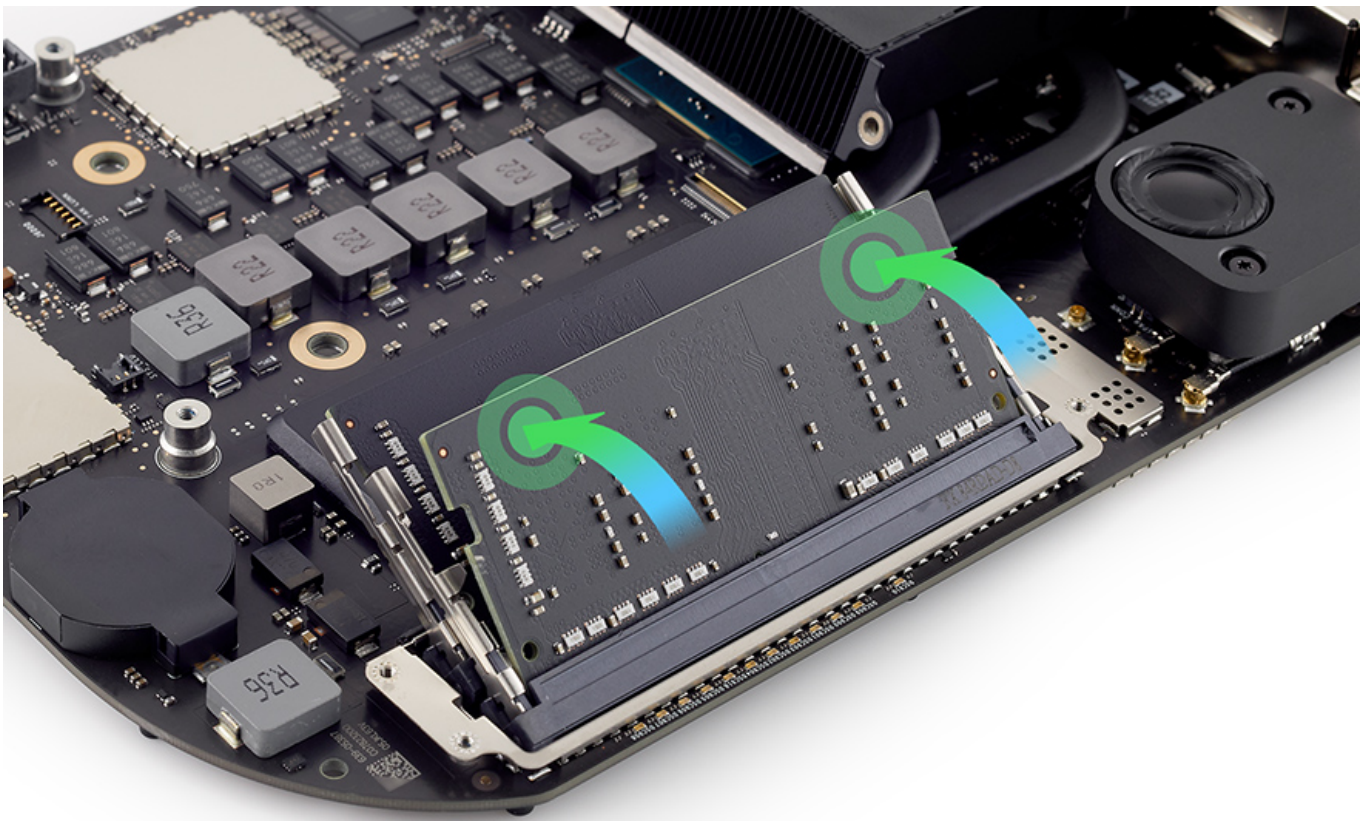
3. Push evenly on both sides of the memory module.



Note: The springs should lock into place around the edges of the memory module.



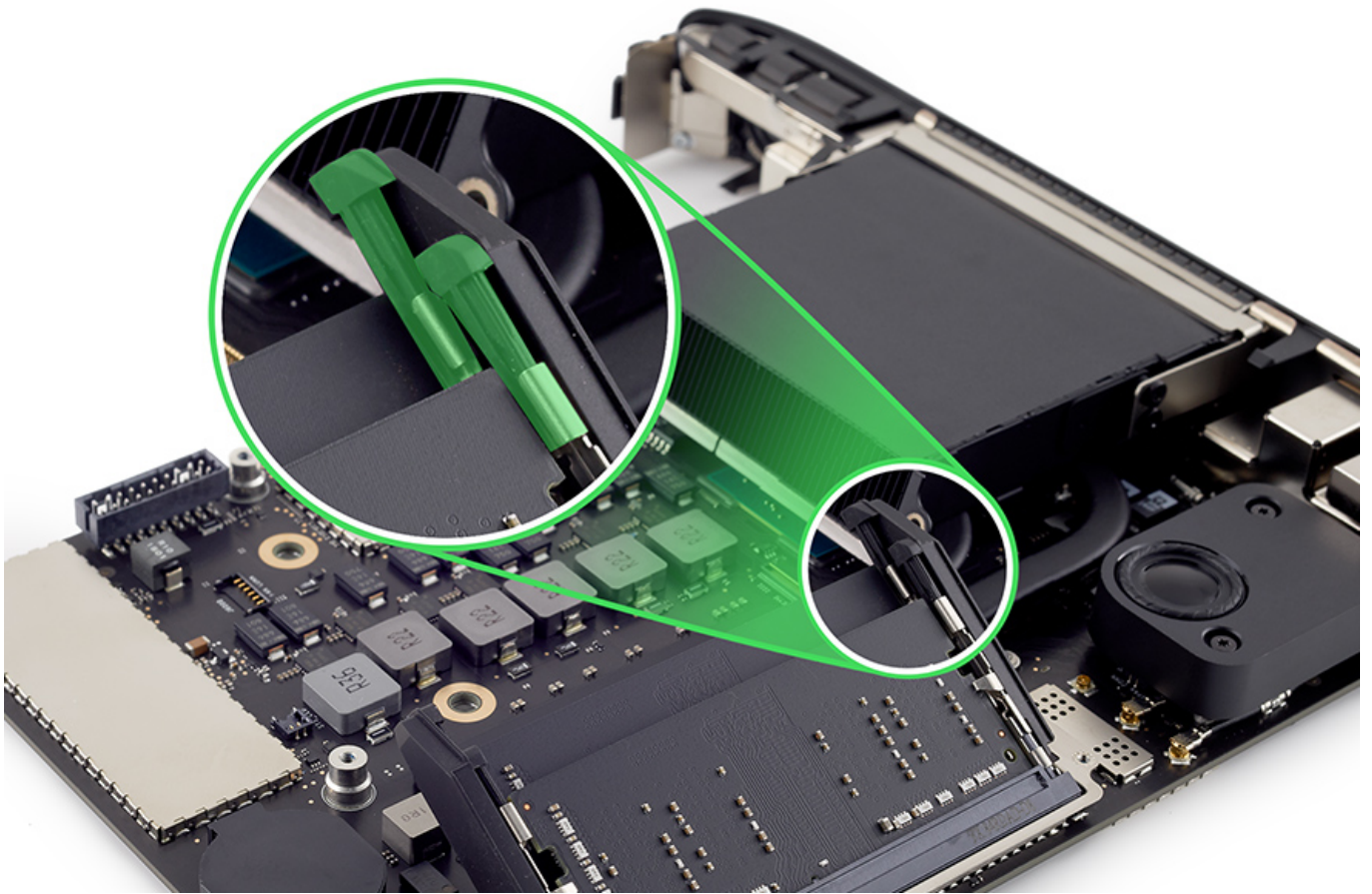
4. Repeat the process for the front memory module.



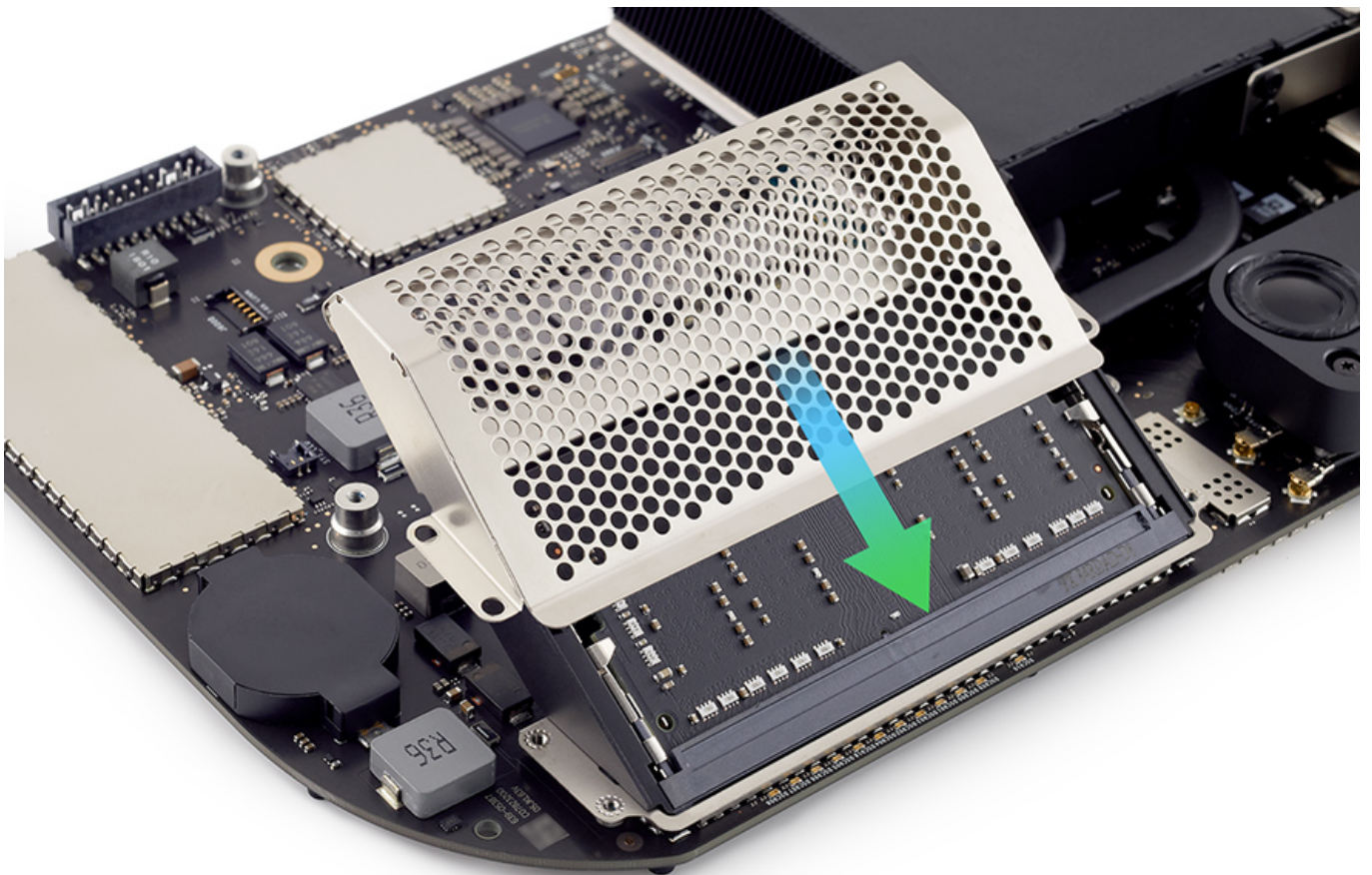
5. Align the bumper ribs with the slots in the memory springs. Slide them into place.
Note: Wipe the ribs with an isopropyl alcohol (IPA) wipe for easier installation.

- Left and right bumpers: 923-02792
(bumpers are not interchangeable)



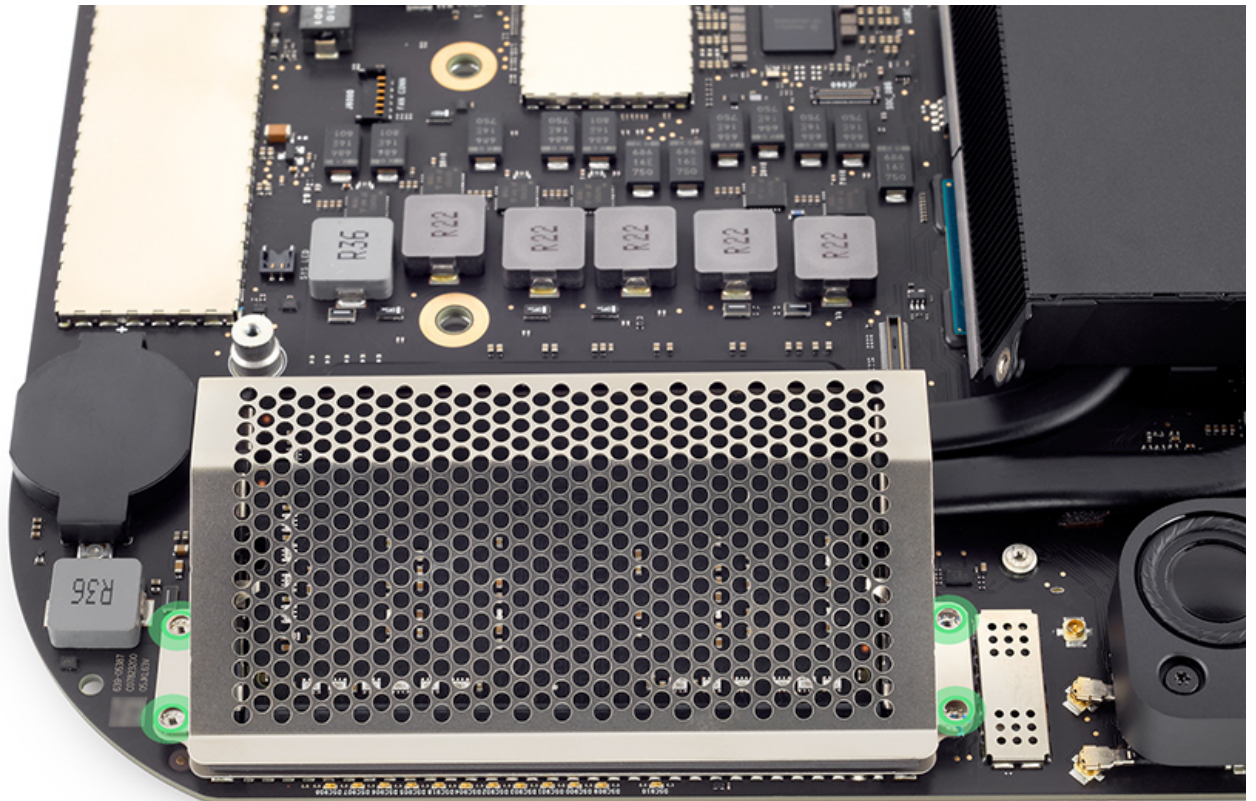


6. Slide the memory cover over the bumpers.



7. Reinstall the four T5 screws.

- T5: 923-02798



8. Reinstall the [logic board](#).
9. Reinstall the [fan](#).
10. Reinstall the [antenna plate](#).
11. Reinstall the [bottom cover](#).

Mac mini (2018) Speaker

First Steps



Warning:

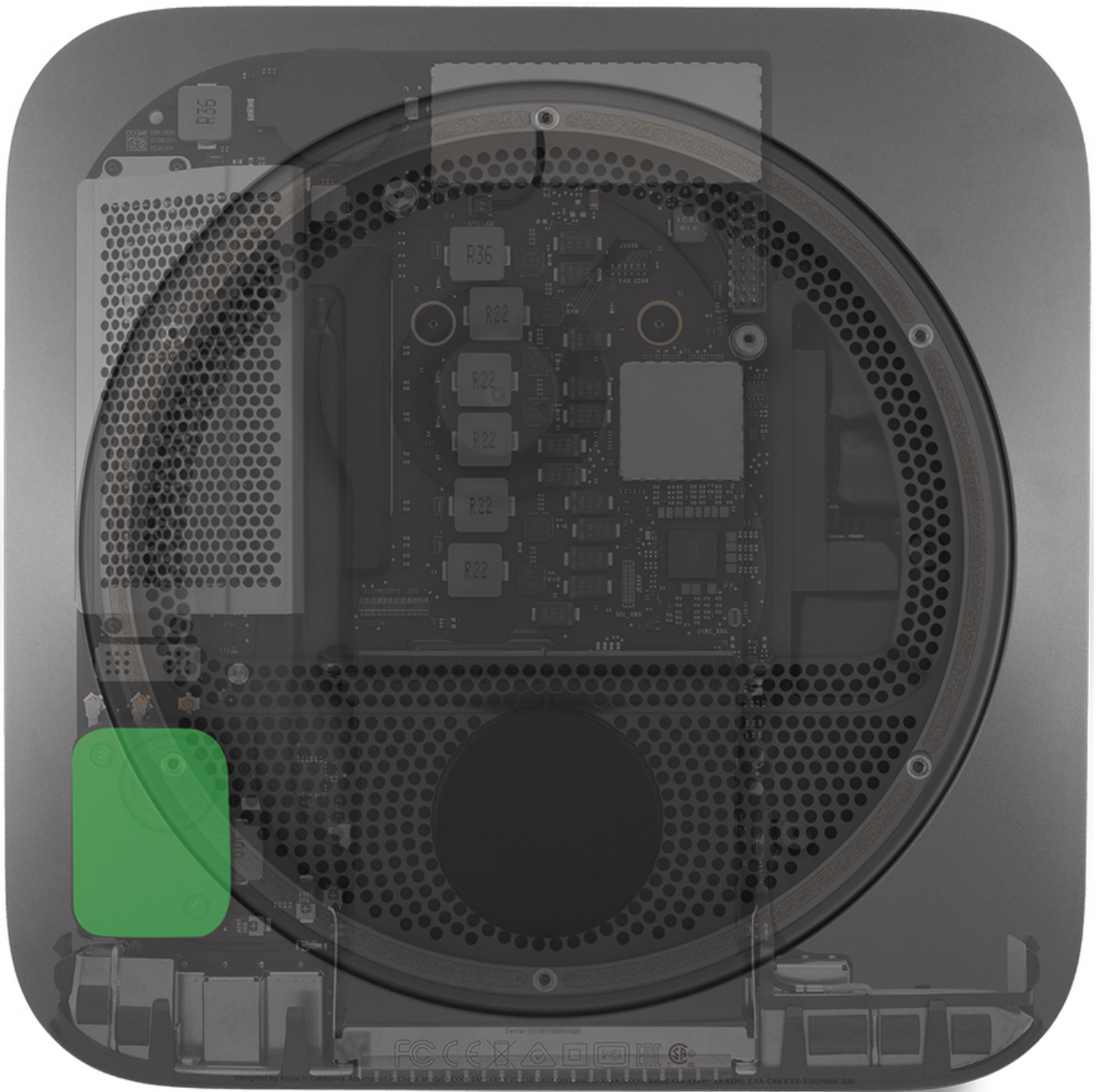
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Cover](#)
- [Antenna Plate](#)
- [Fan](#)
- [Logic Board](#)



Tools

- Black stick
- Torx T6 screwdriver (magnetized)

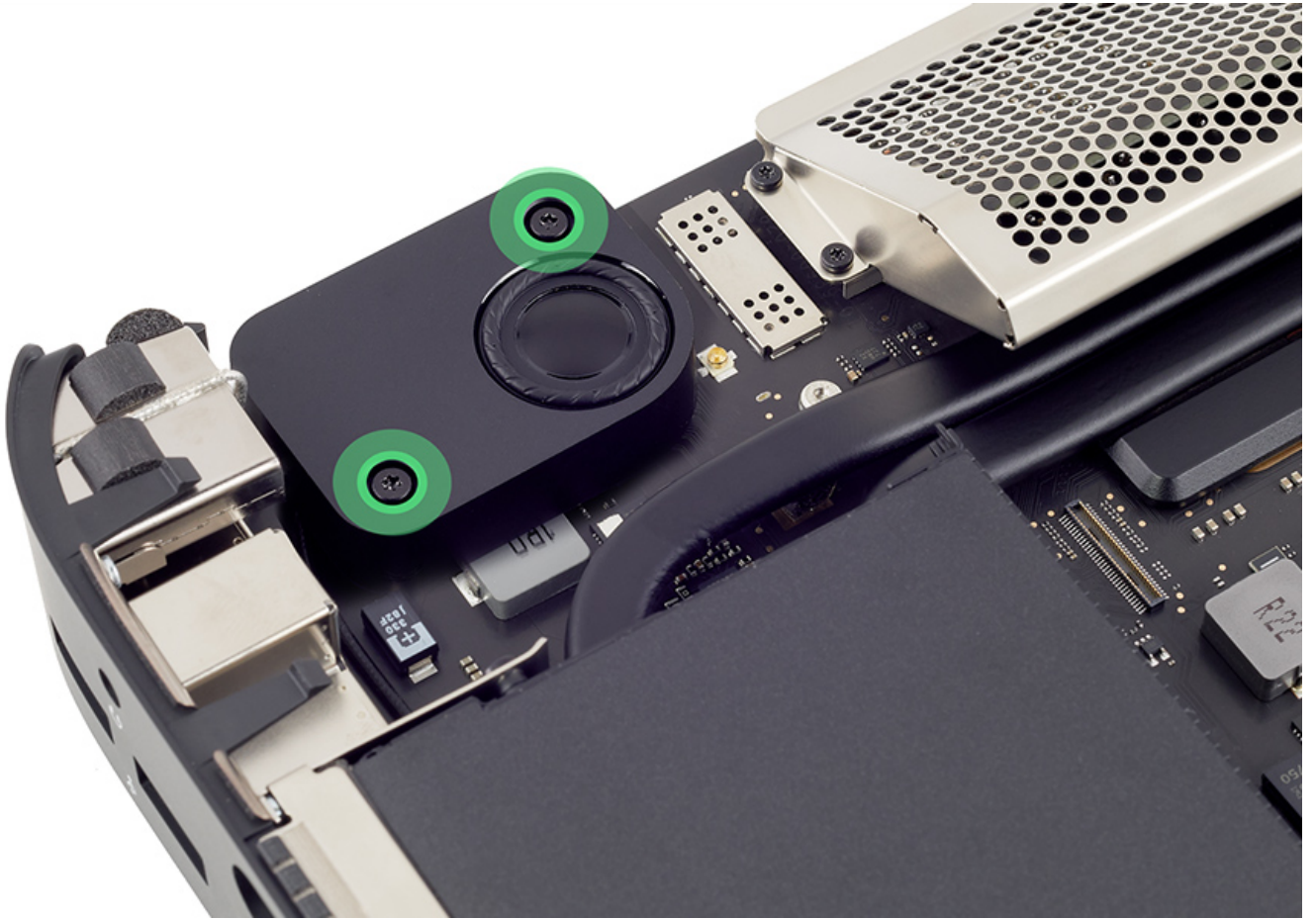


Steps For Removal

1. Remove two T6 screws from the speaker.

Important: The speaker cable is connected to the logic board directly beneath the speaker assembly.

- T6: 923-02801

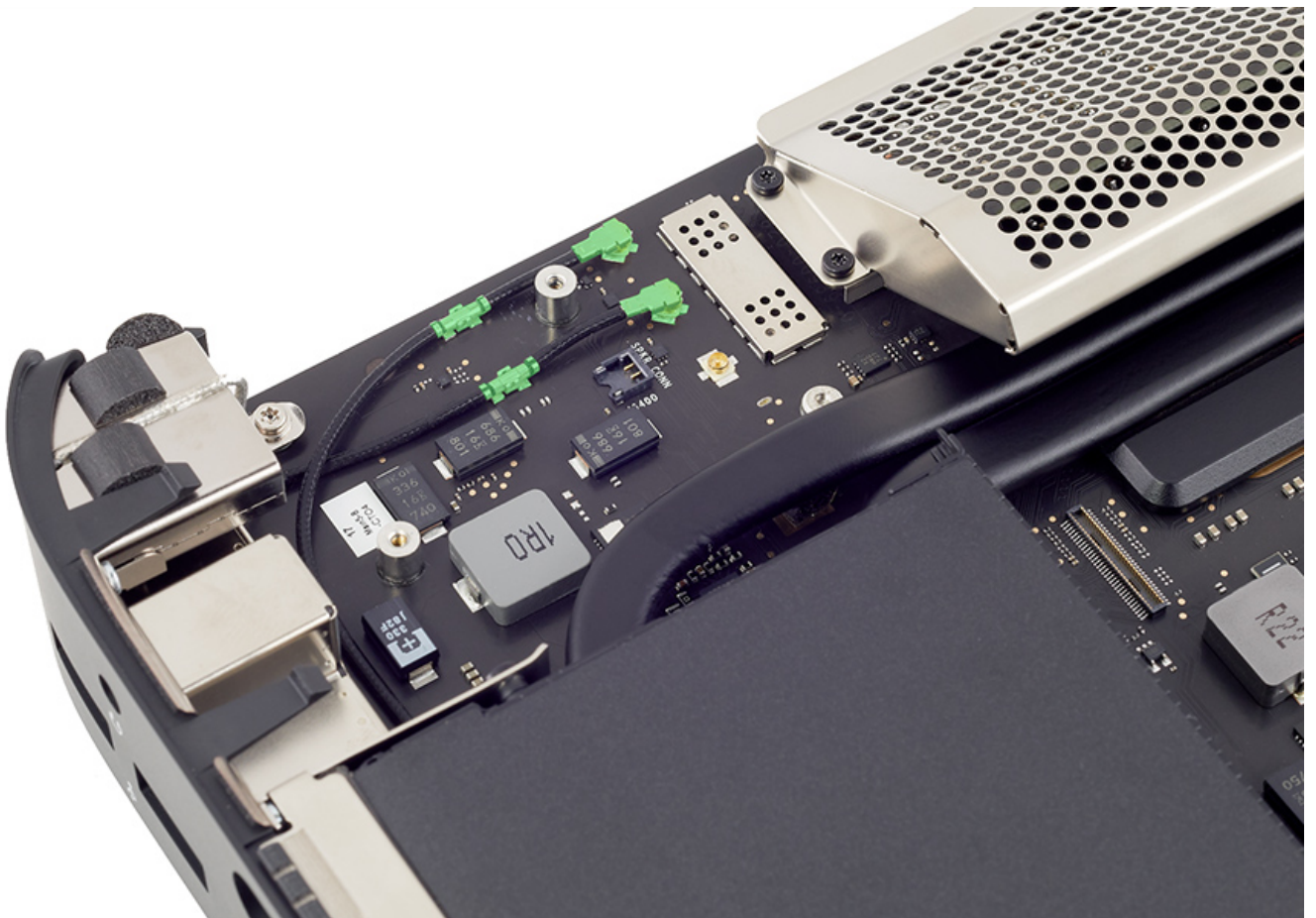


2. Lift the speaker to the side and use a black stick to disconnect the speaker cable from the logic board.

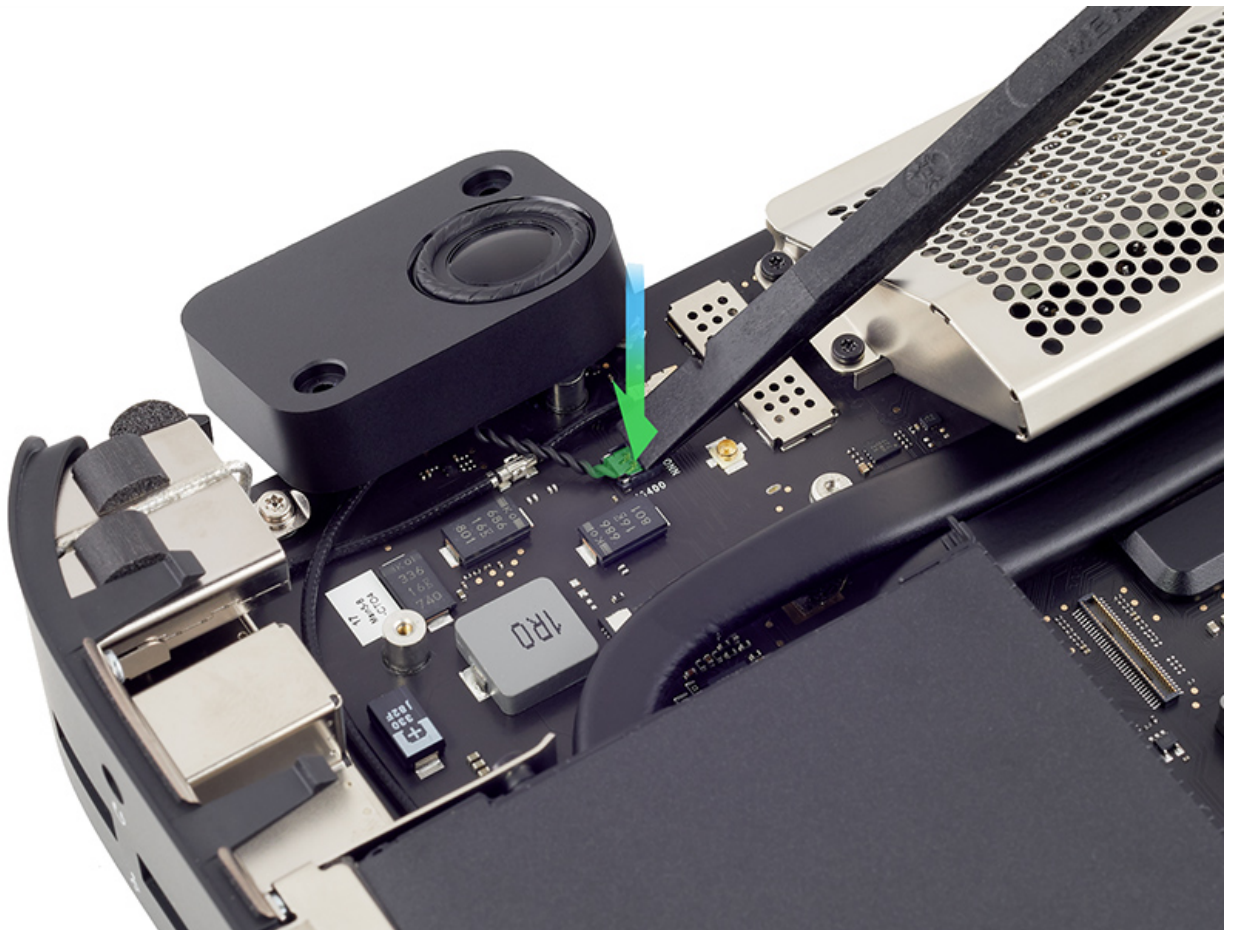


Steps For Reassembly

1. Verify the antenna cables are secured to the ground clips and the antenna heads are connected to the logic board.



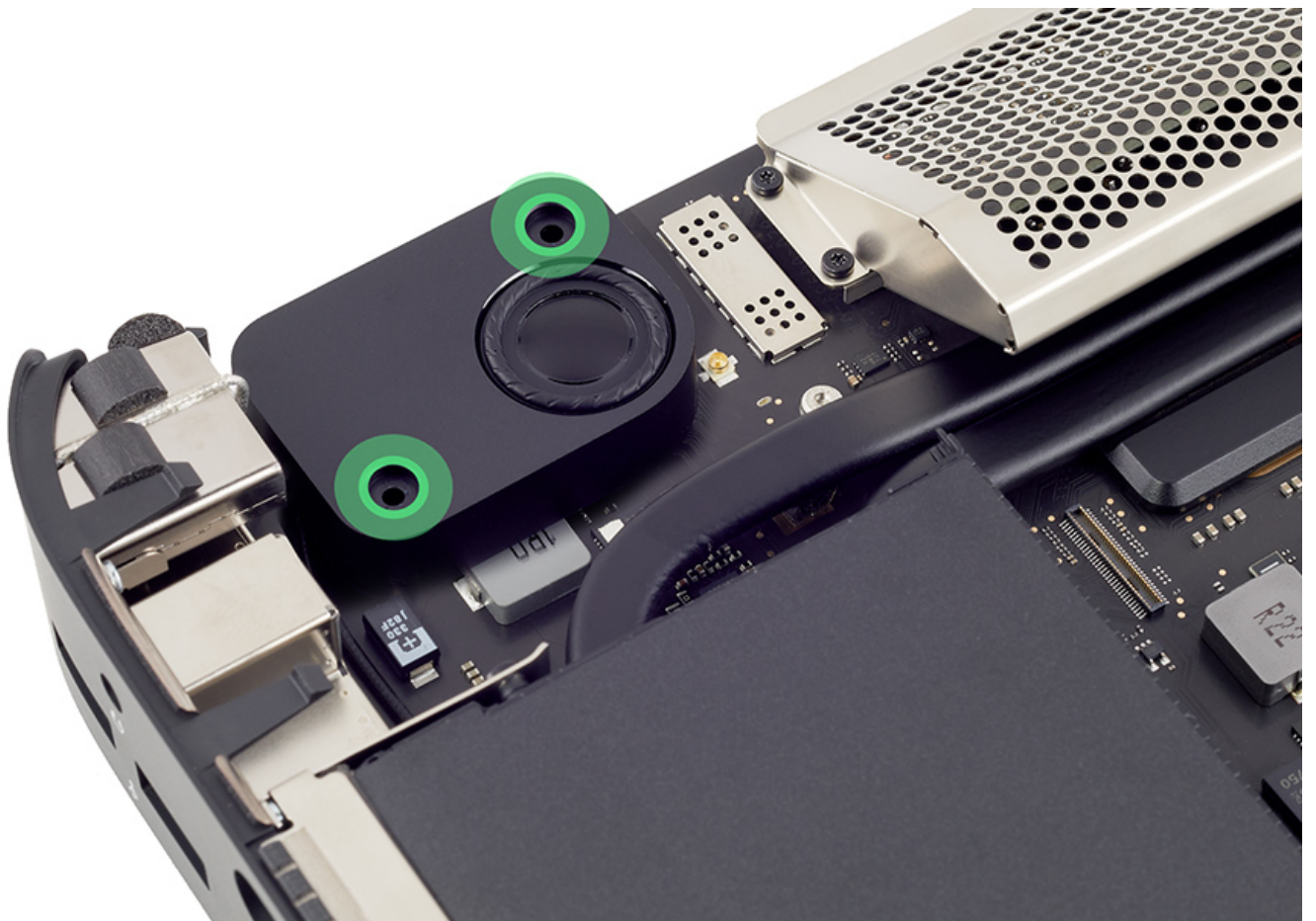
2. Connect the speaker cable to the logic board.



3. Align the speaker screw holes with the standoffs on the logic board and reinstall the two T6 screws.

- T6: 923-02801





4. Reinstall the [logic board](#).
5. Reinstall the [fan](#).
6. Reinstall the [antenna plate](#).
7. Reinstall the [bottom cover](#).

Mac mini (2018) Coin Cell Battery

First Steps



Warning:

- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Cover](#)
- [Antenna Plate](#)
- [Fan](#)
- [Logic Board](#)



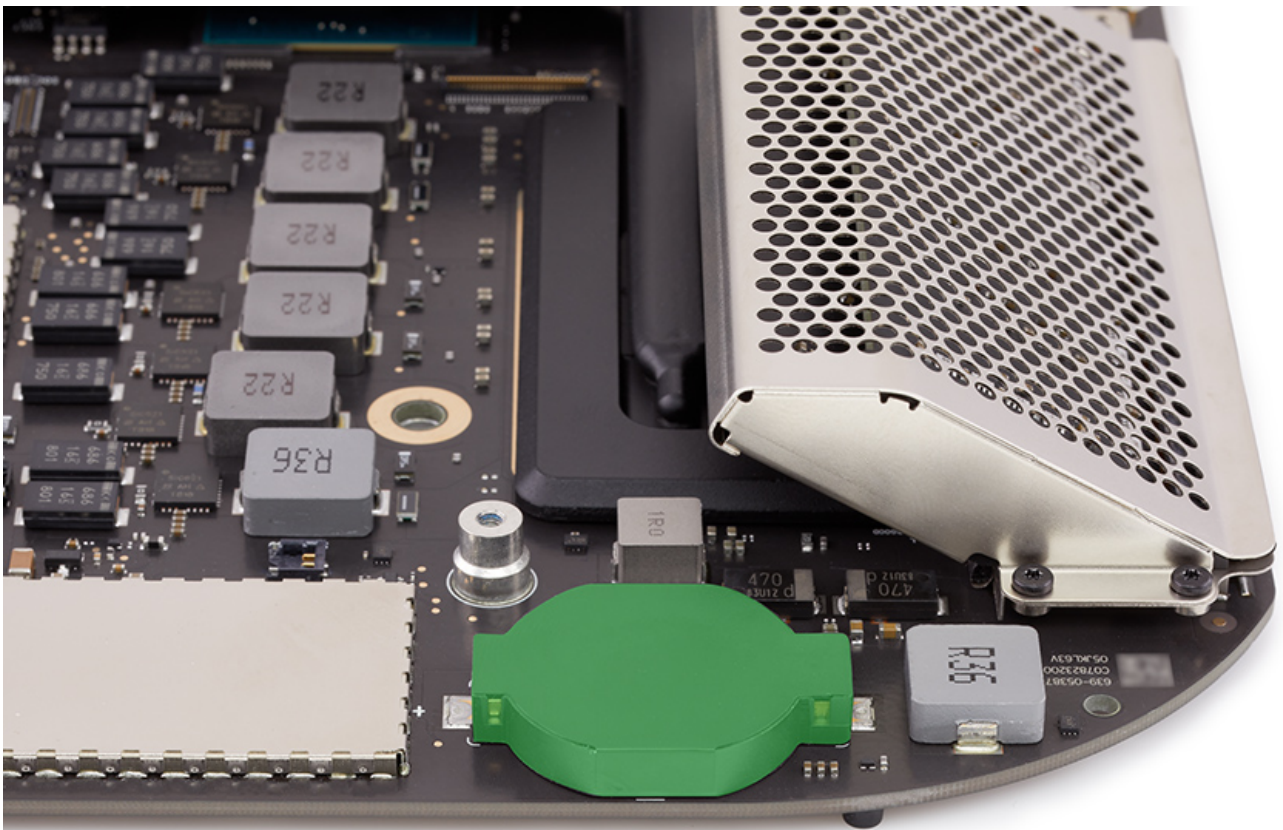
Tools

- Black stick
- ESD-tweezers



Steps For Removal

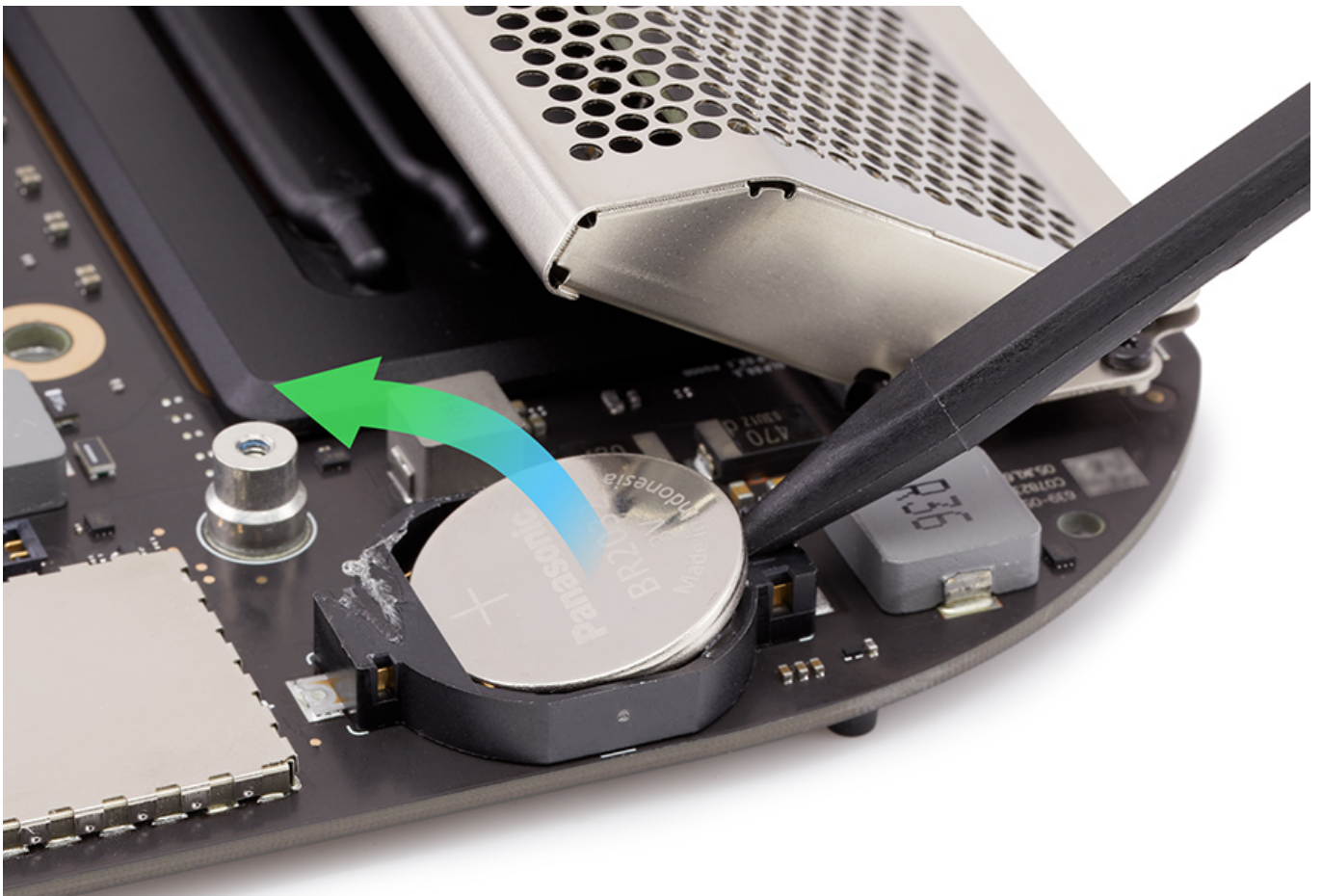
1. Locate the coin cell battery on the logic board.



2. Use tweezers to peel back the edges of the adhesive cover.
Important: Save the adhesive cover for reuse.



3. Place the pointed end of a black stick under the edge of the battery and lift up.

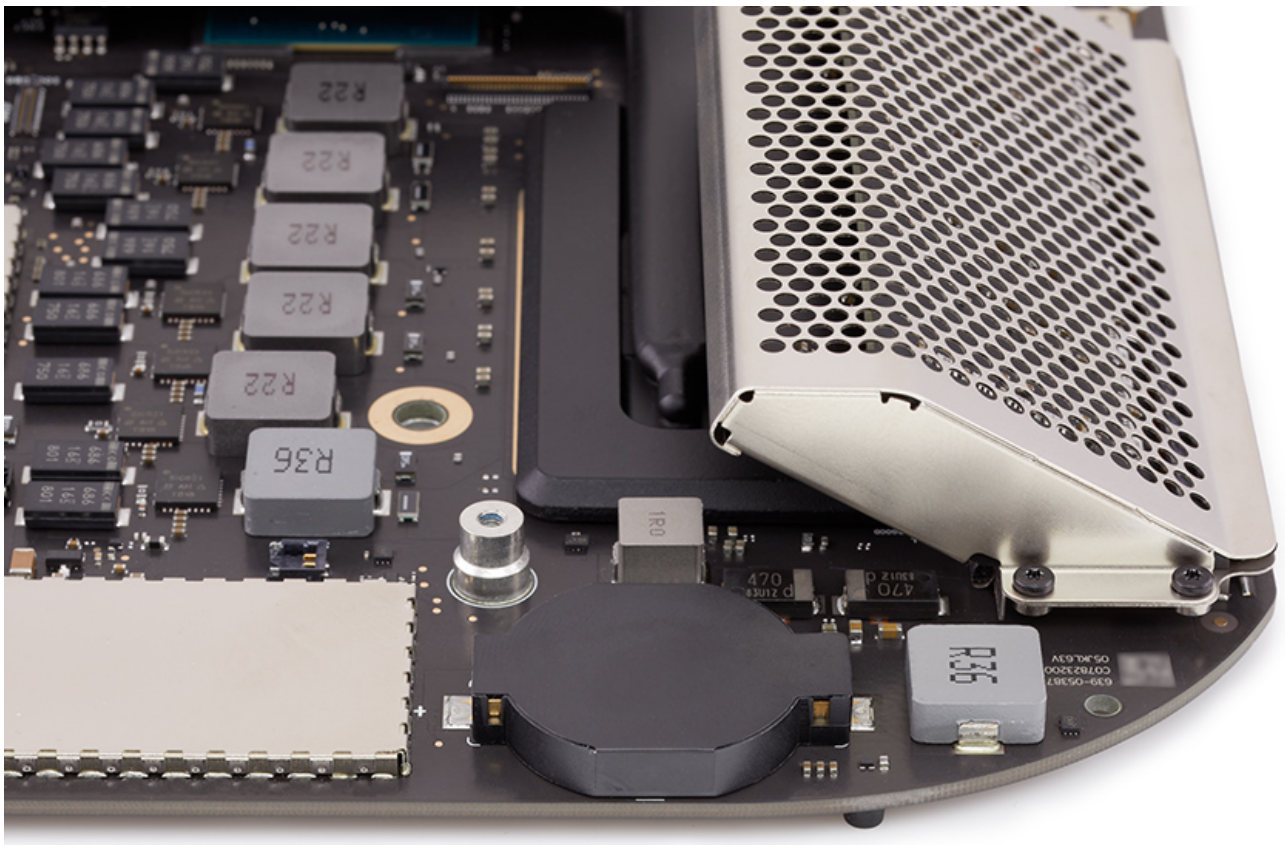


Steps For Reassembly

1. Insert the battery with the positive side facing up.



2. Reapply the adhesive cover.



3. Reinstall the [logic board](#).
4. Reinstall the [fan](#).
5. Reinstall the [antenna plate](#).
6. Reinstall the [bottom cover](#).

Mac mini (2018) I/O Wall

First Steps



Warning:

- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Cover](#)
- [Antenna Plate](#)
- [Fan](#)
- [Logic Board](#)
- [Speaker](#)



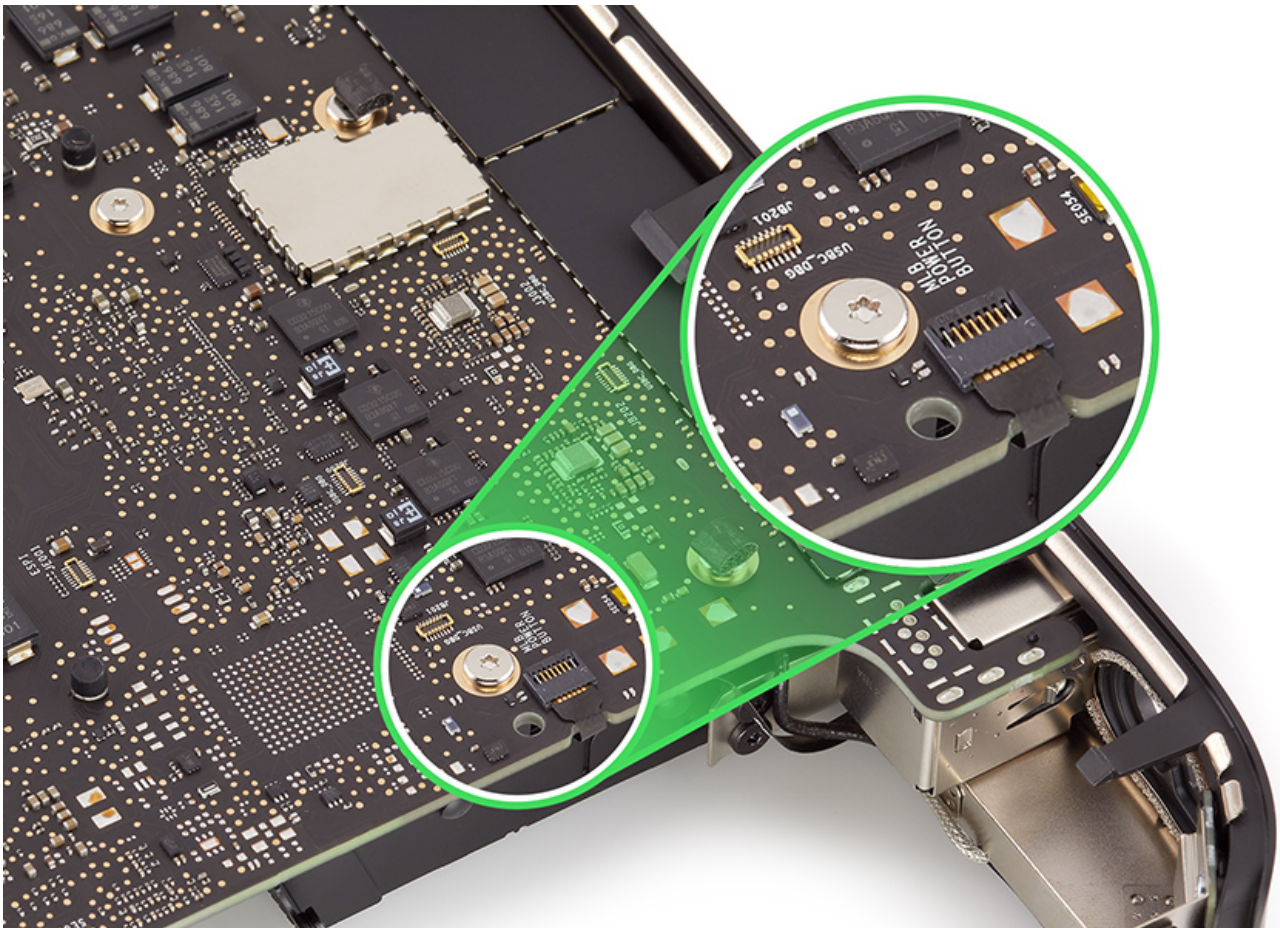
Tools

- Black stick
- Torx T6 screwdriver (magnetized)
- Antenna tool (923-01322)

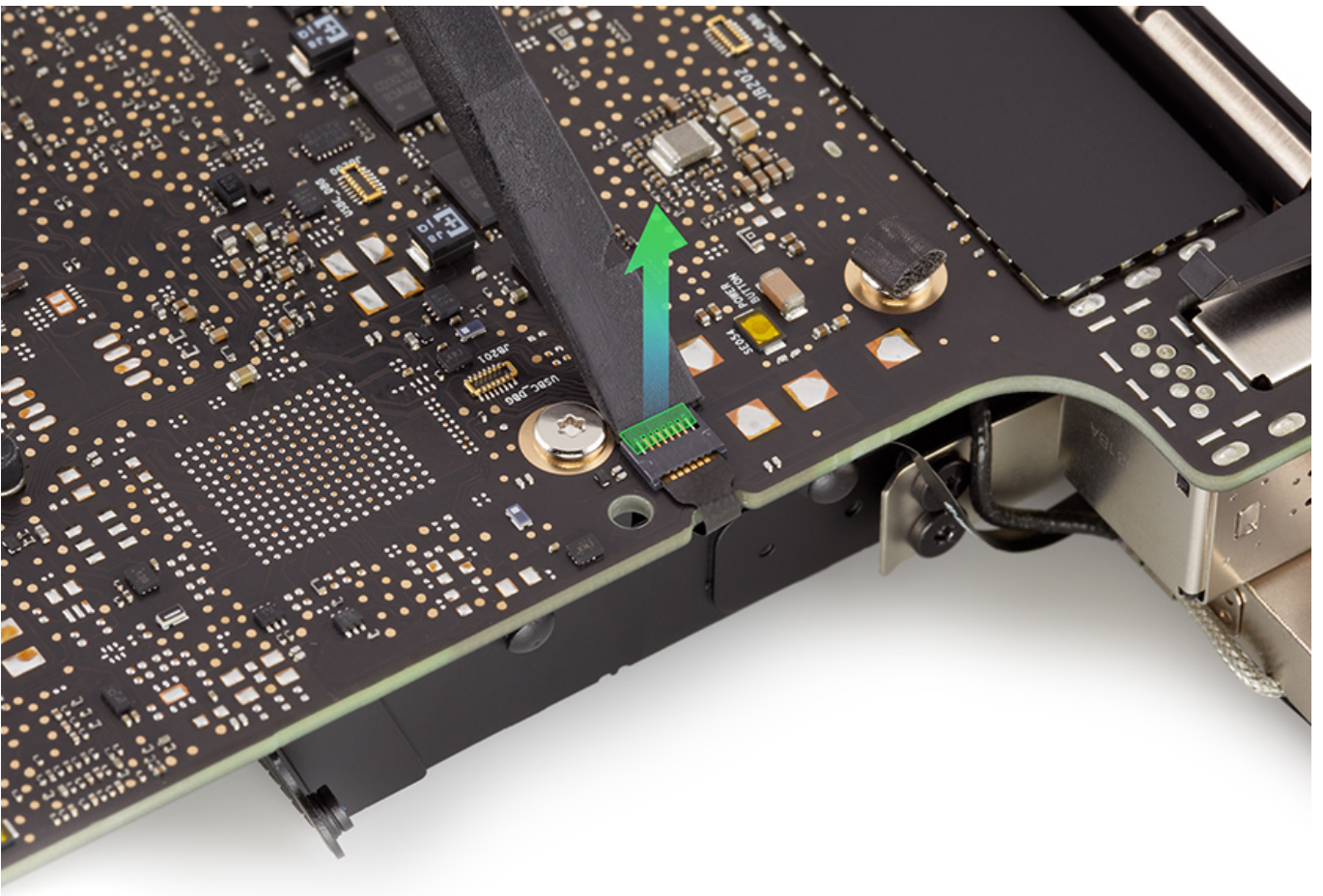


Steps For Removal

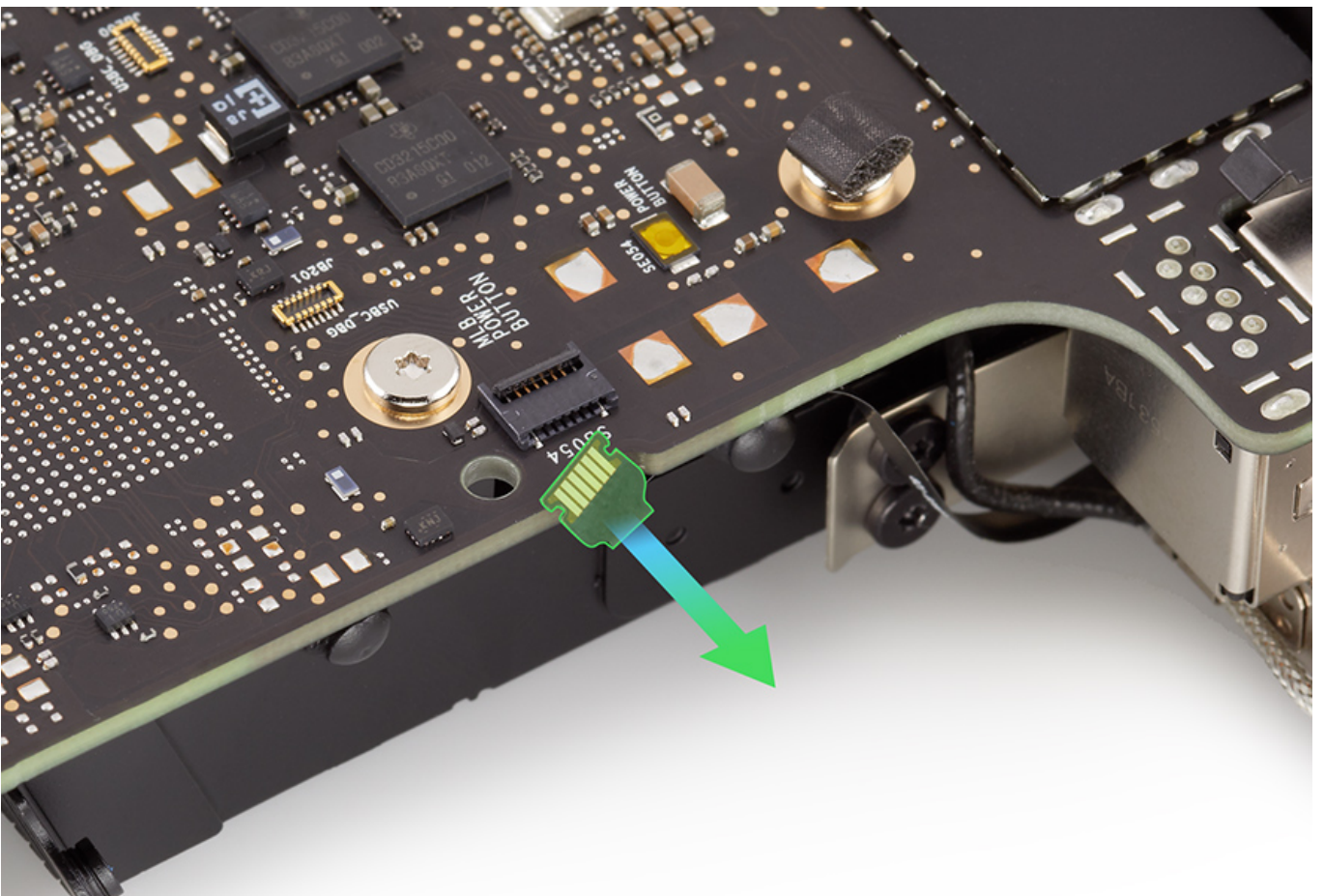
1. Turn over the logic board and locate the power button flex cable.



2. Use the flat end of a black stick to flip the locking lever up.



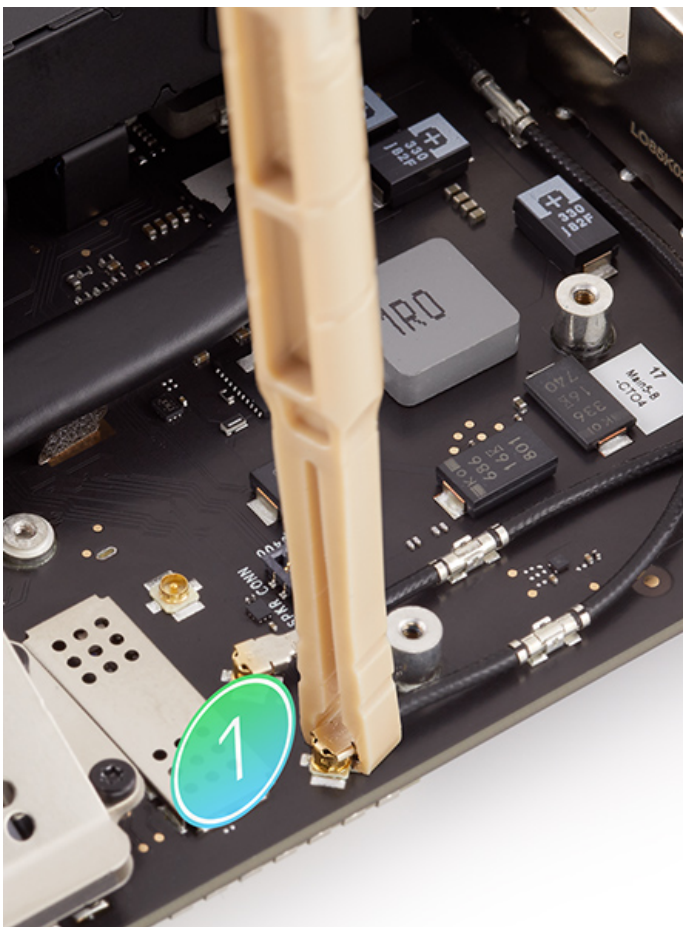
3. Disconnect the power button flex cable.



4. Turn over the logic board. Use the flat end of a black stick to loosen the adhesive between the logic board and power button flex cable.



5. Rotate the logic board to access the antenna cables. Use the antenna tool to disconnect the two antenna cables from the logic board.



6. Lift up on the antenna cables to remove them from the three ground clips.



7. Remove one T6 ground screw and two T6 heat sink screws.

- T6 ground screw: 923-00230



- T6 heat sink screws: 923-02800

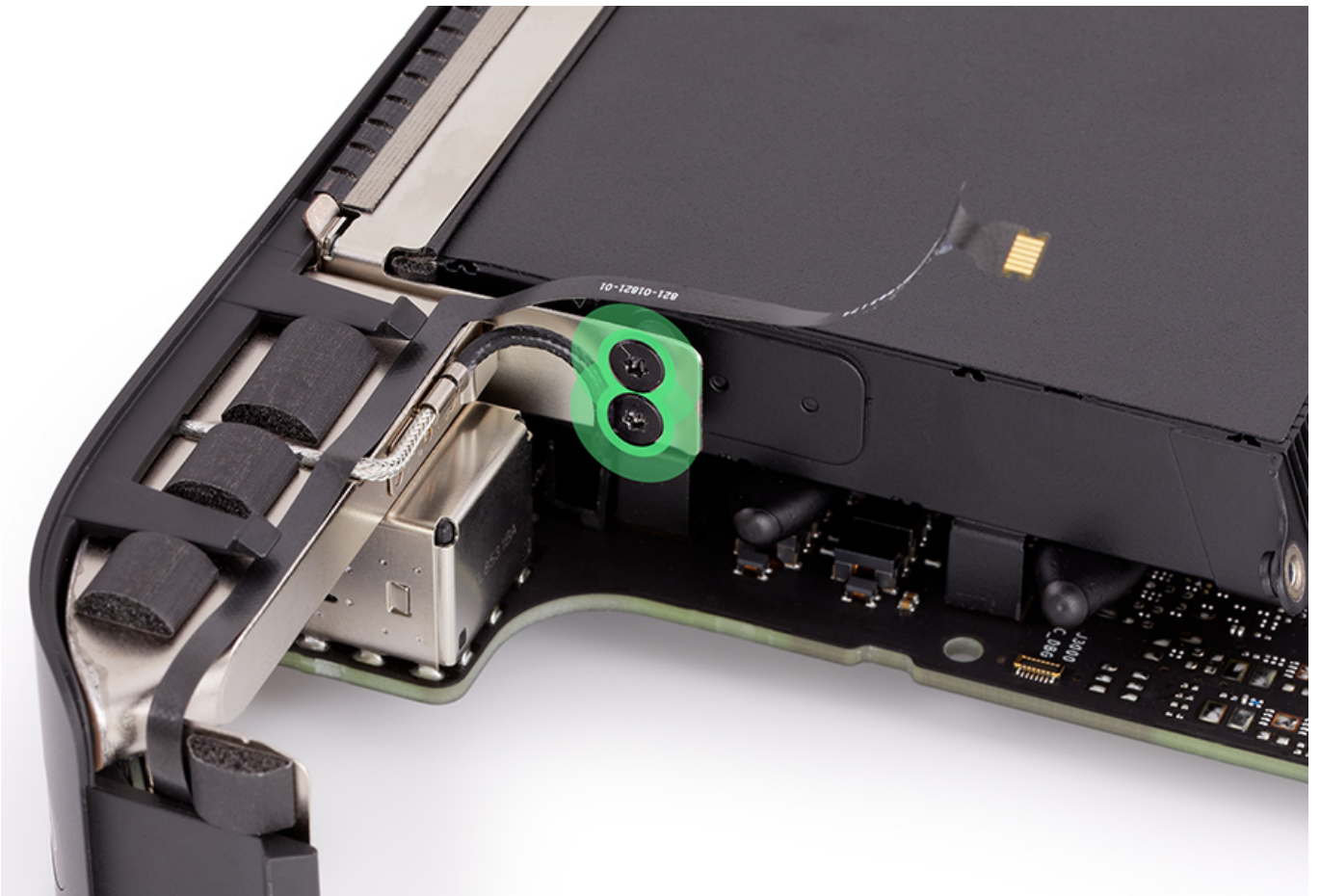




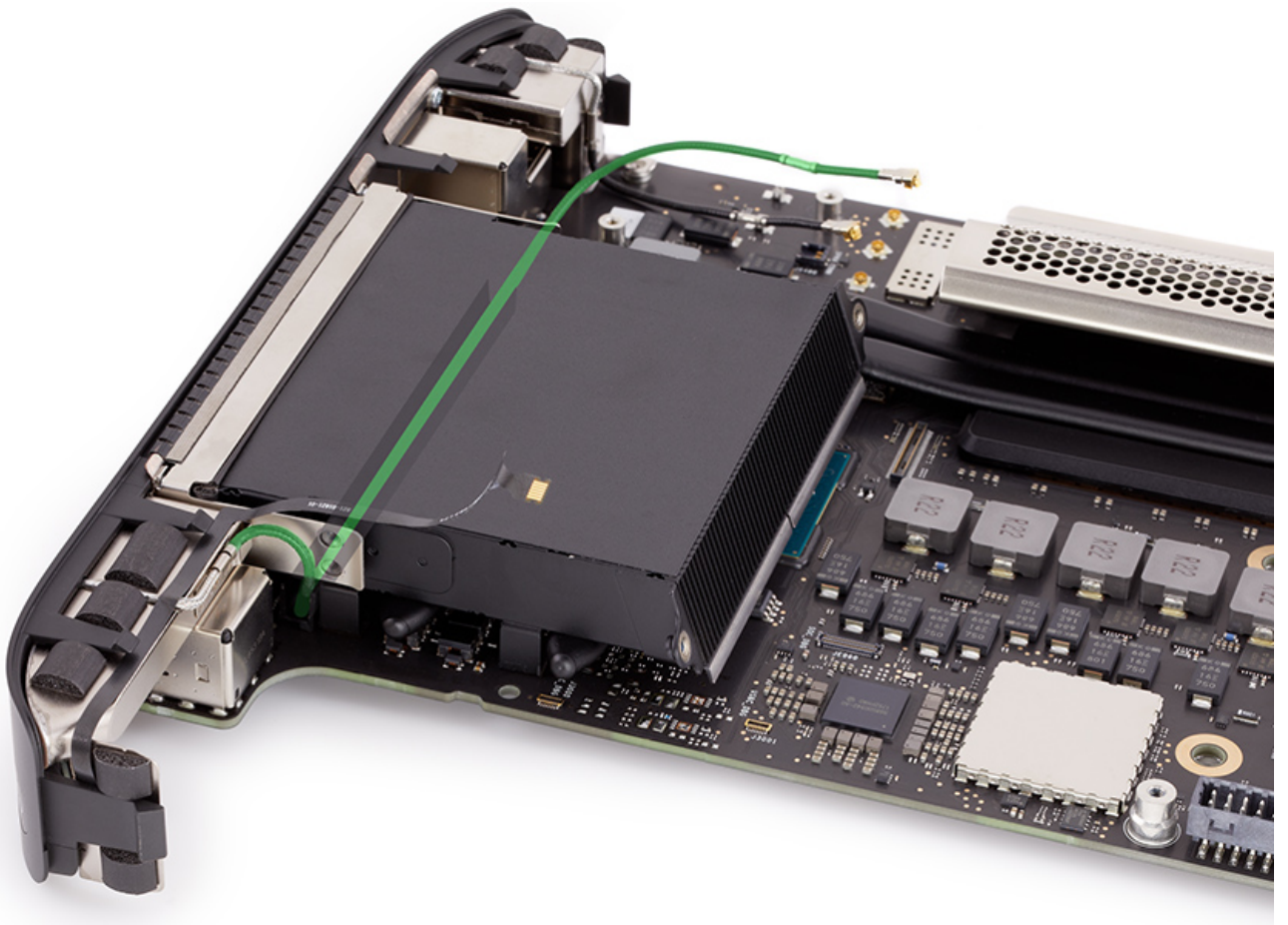
8. Remove two additional T6 heat sink screws from the other side of the heat sink.

- T6 heat sink screws: 923-02800





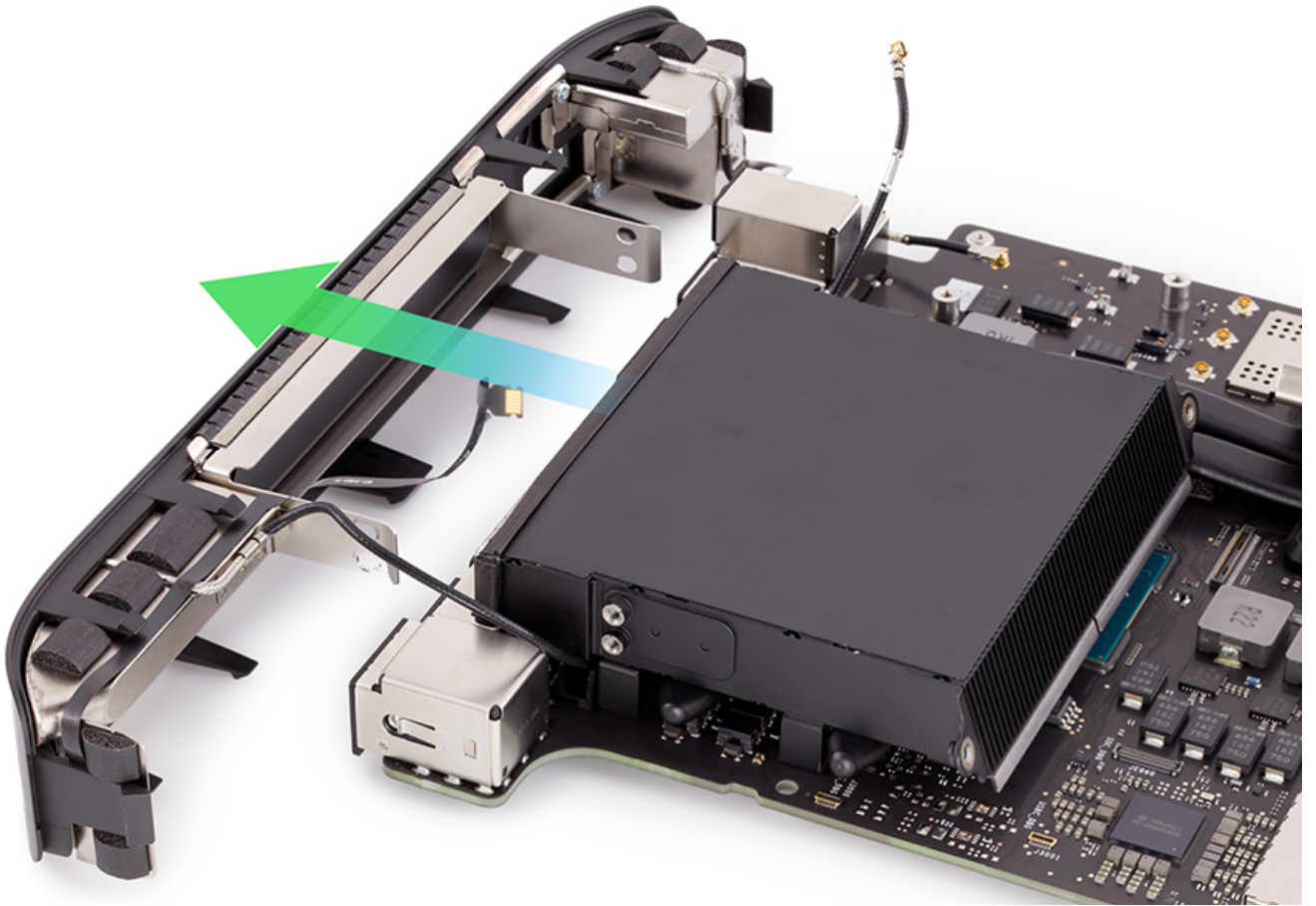
Important: The two antenna cables are attached to the I/O wall. The long antenna cable routes through a channel underneath the heat sink as illustrated in the following image. To avoid damage to the antenna cable, pull the cable slowly through the channel and stop if you feel resistance.



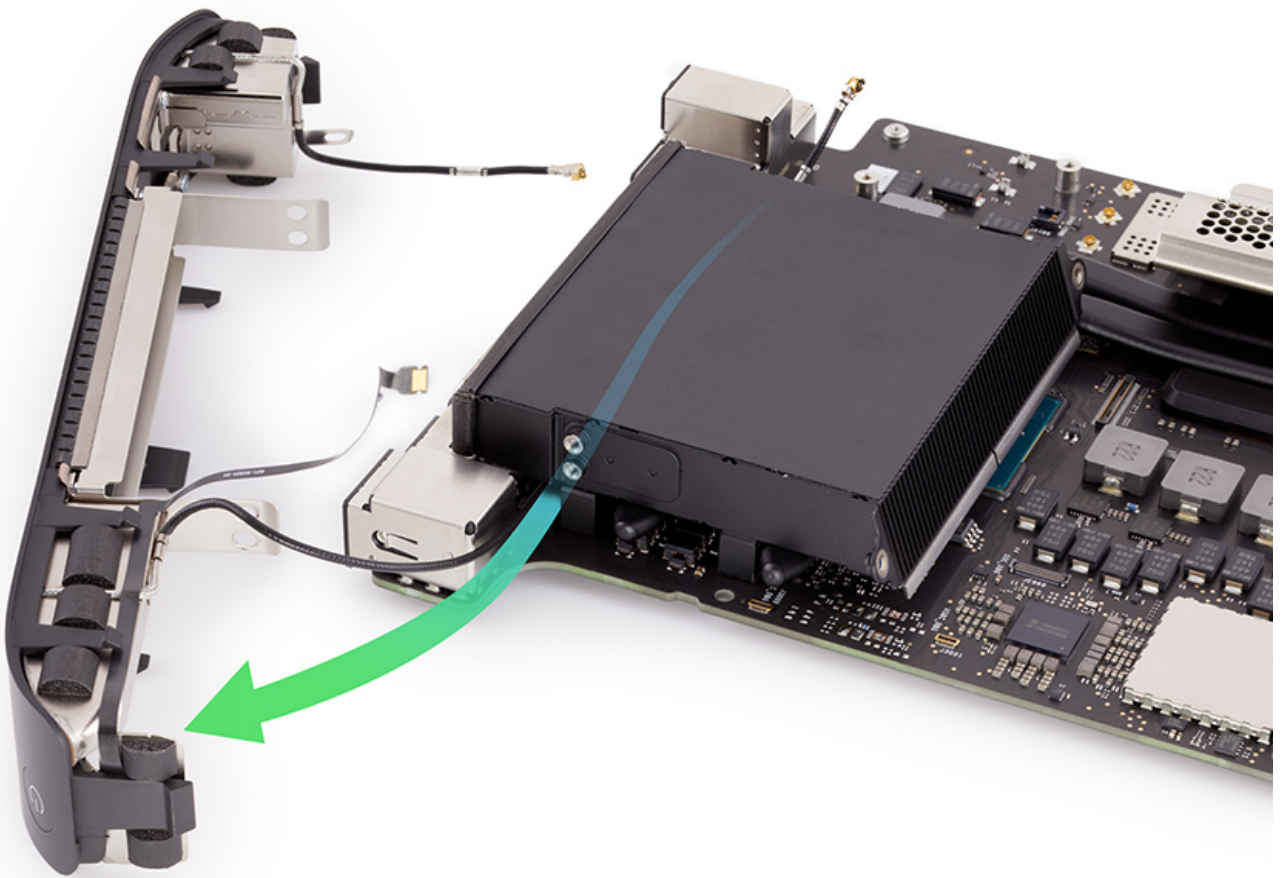
9. Pull 1 inch (2.5-cm) of the antenna cable through the channel underneath the heat sink.



10. Separate the I/O wall from the logic board and heat sink.

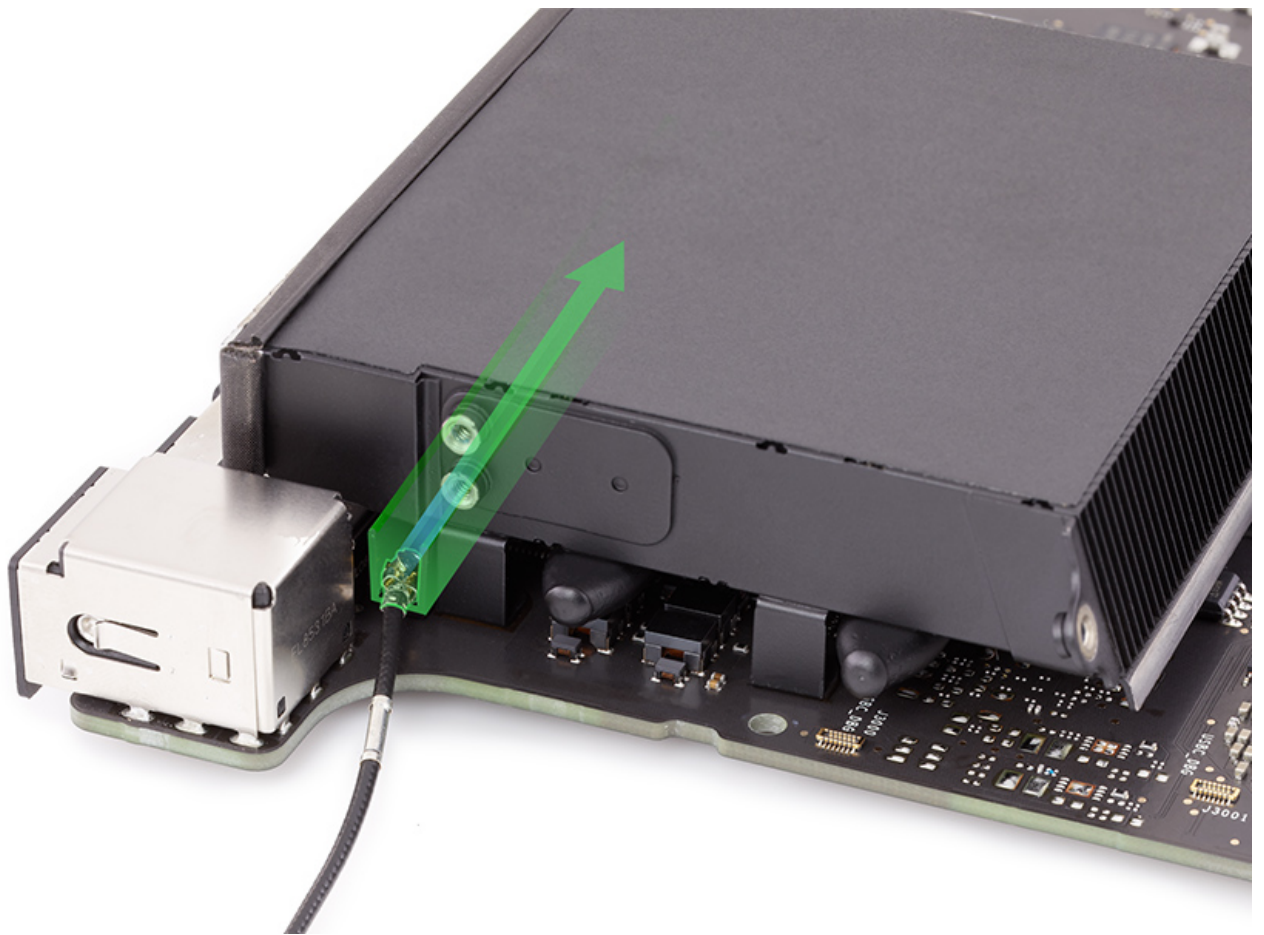


11. Rotate the I/O wall and pull the remainder of the antenna cable through the channel.

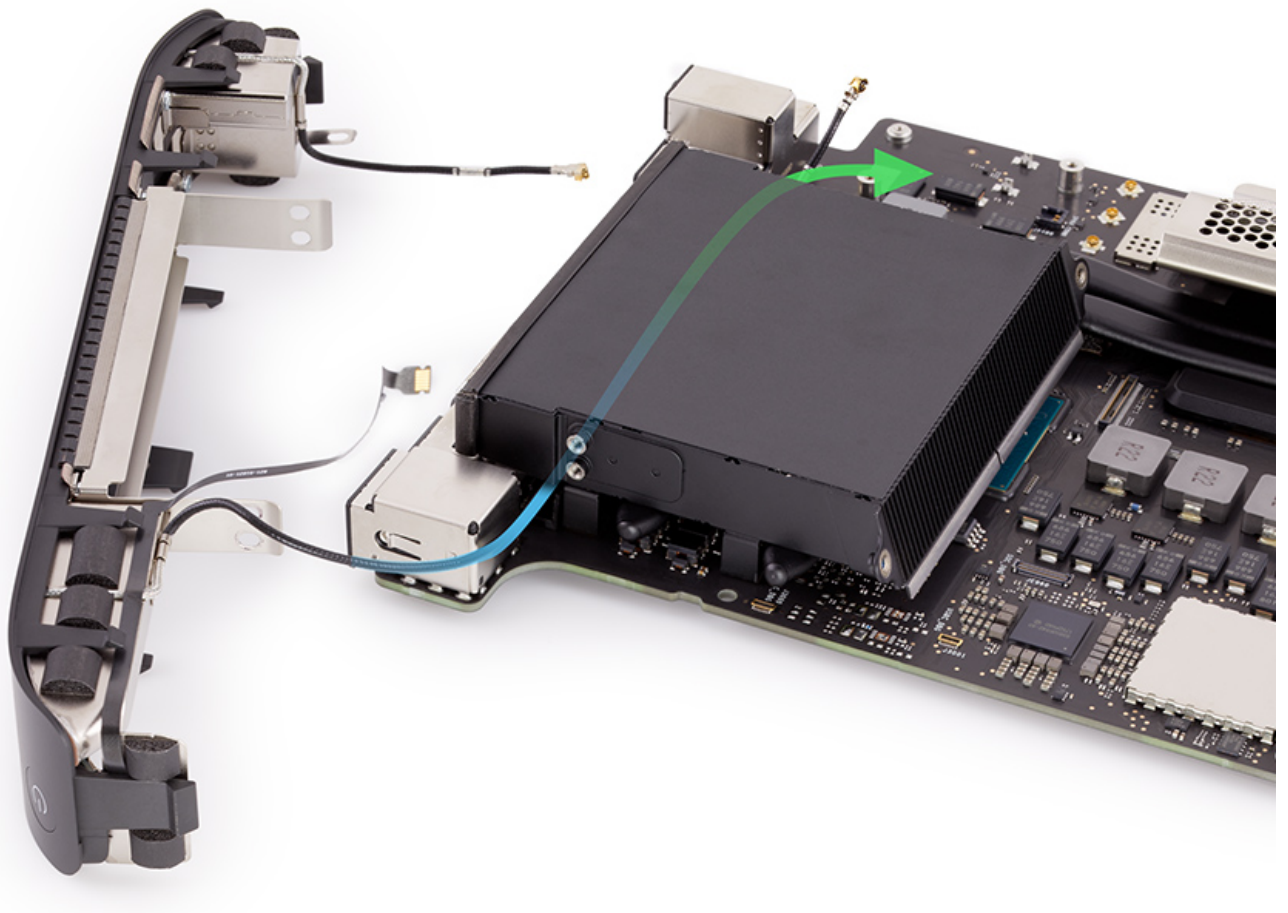


Steps For Reassembly

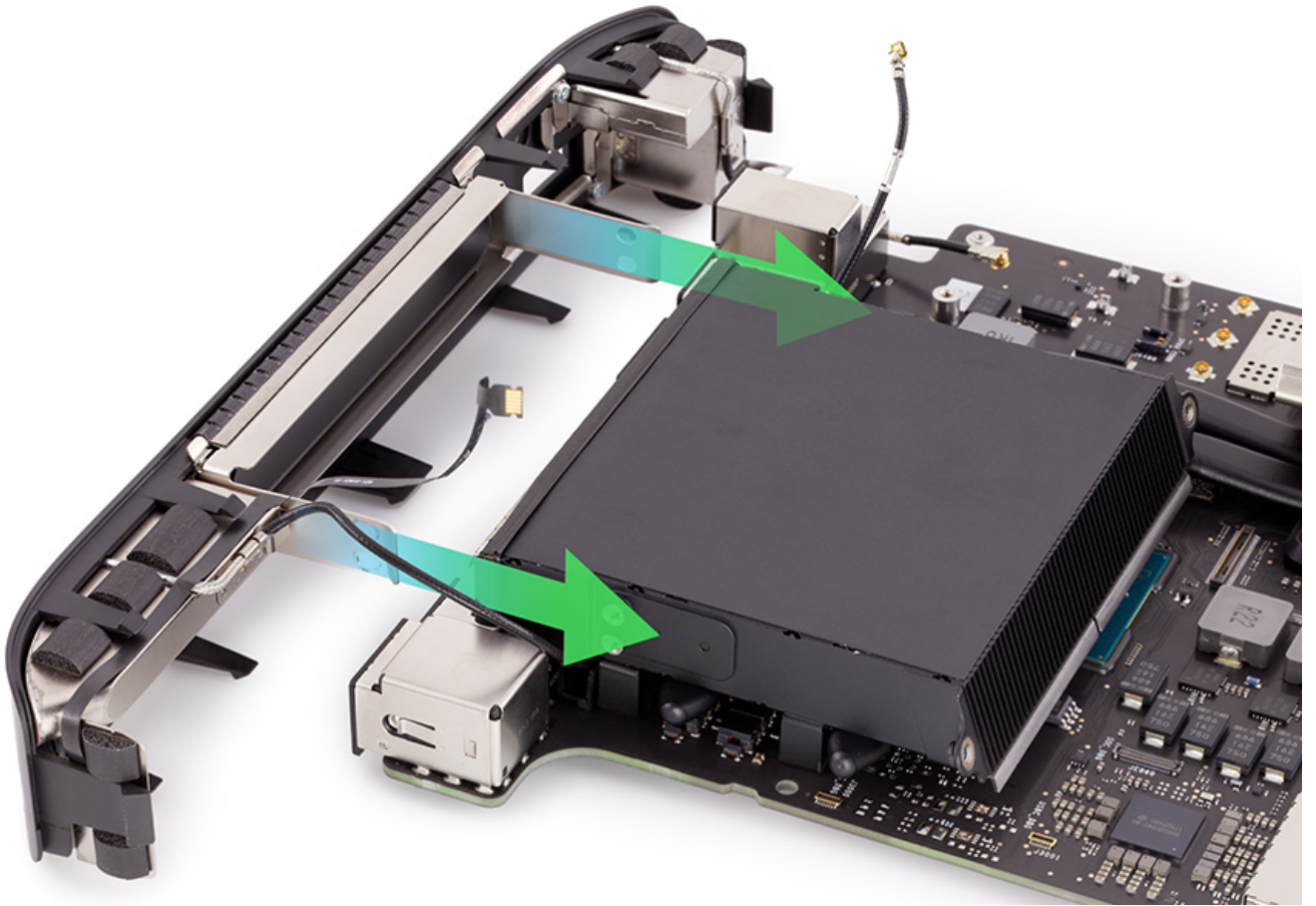
1. Insert the antenna cable into the channel underneath the heat sink.



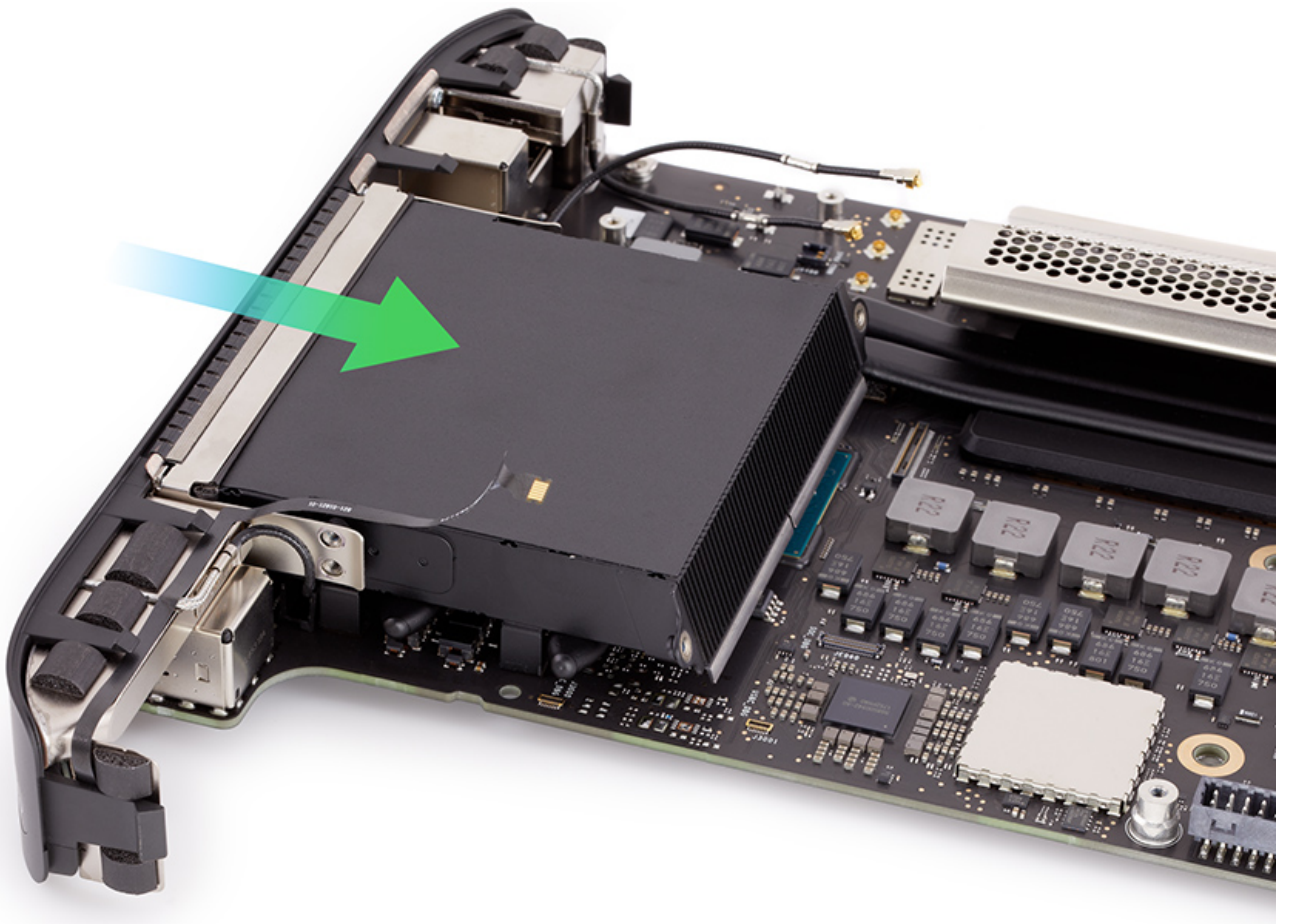
2. Continue routing the antenna cable through the channel as you rotate the I/O wall into position.



3. Align the mounting brackets of the I/O wall with the sides of the heat sink.

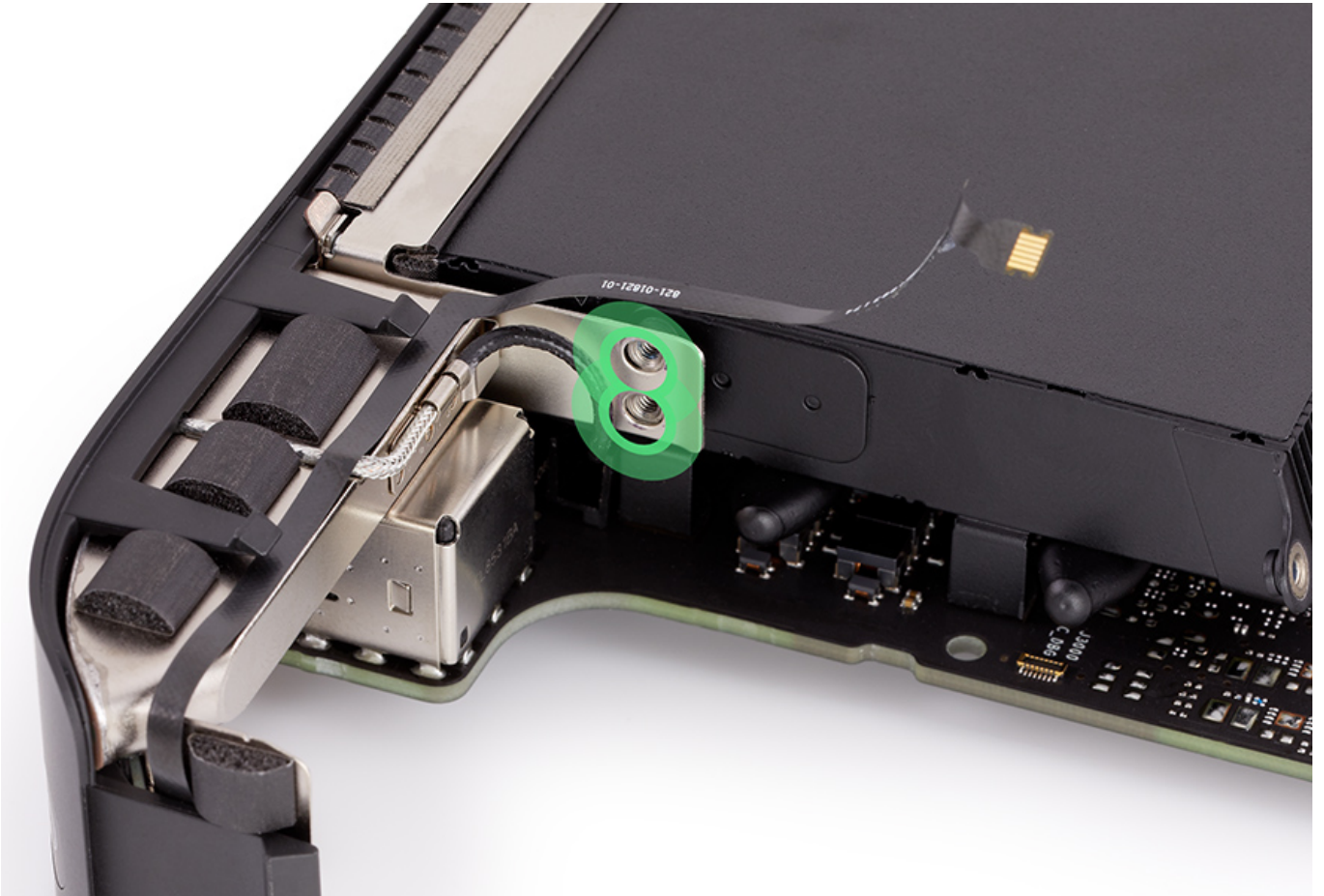


4. Press the I/O wall flush against the logic board and heat sink.



5. Reinstall two T6 heat sink screws.

- T6 heat sink screws: 923-02800



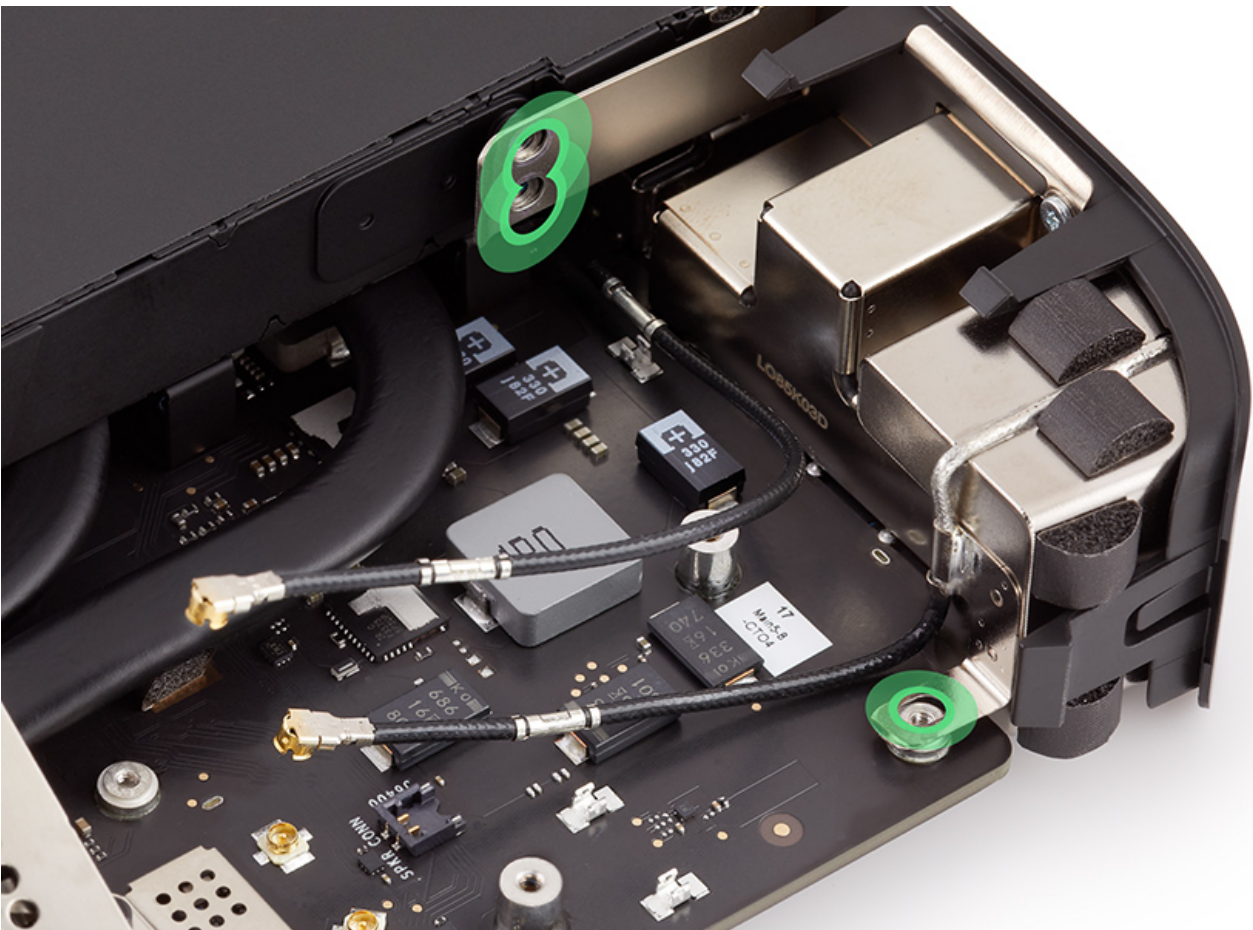
6. Reinstall two additional T6 heat sink screws and one T6 ground screw.

- T6 heat sink screws: 923-02800



- T6 ground screw: 923-00230

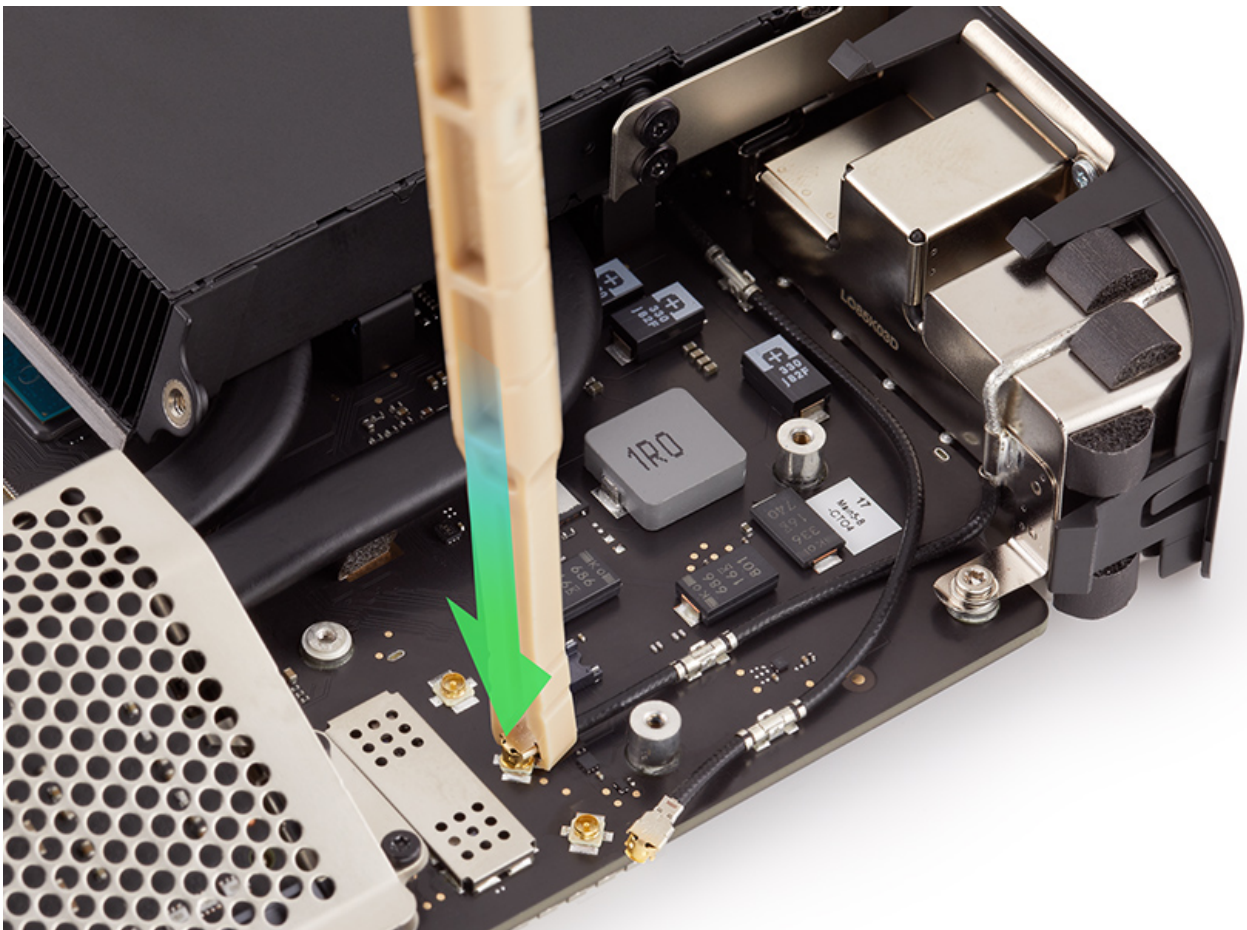




7. Press the antenna cables into the ground clips.
Note: The long antenna cable crosses over the shorter cable.



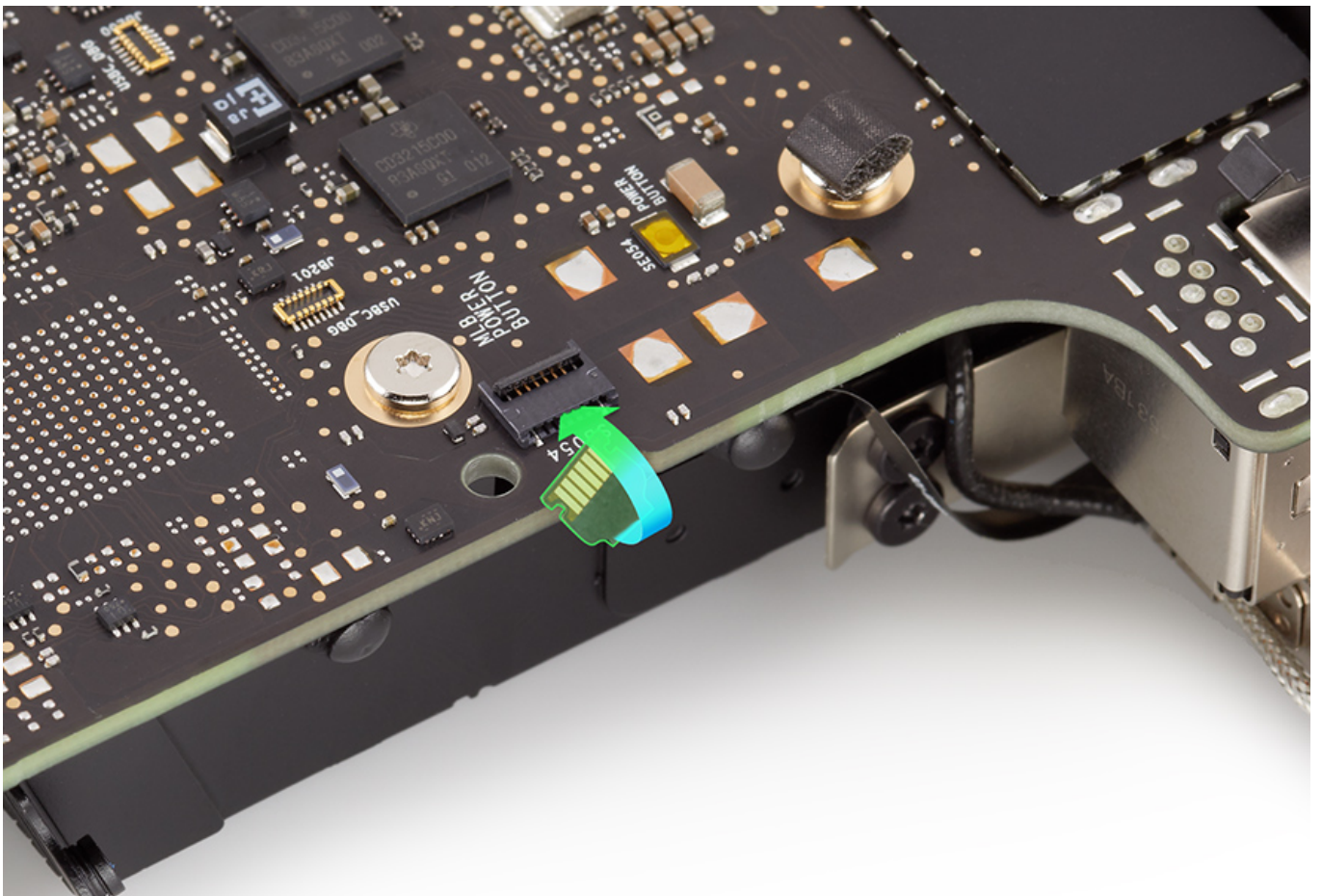
8. Reconnect the two antenna cables to the antenna connectors on the logic board.



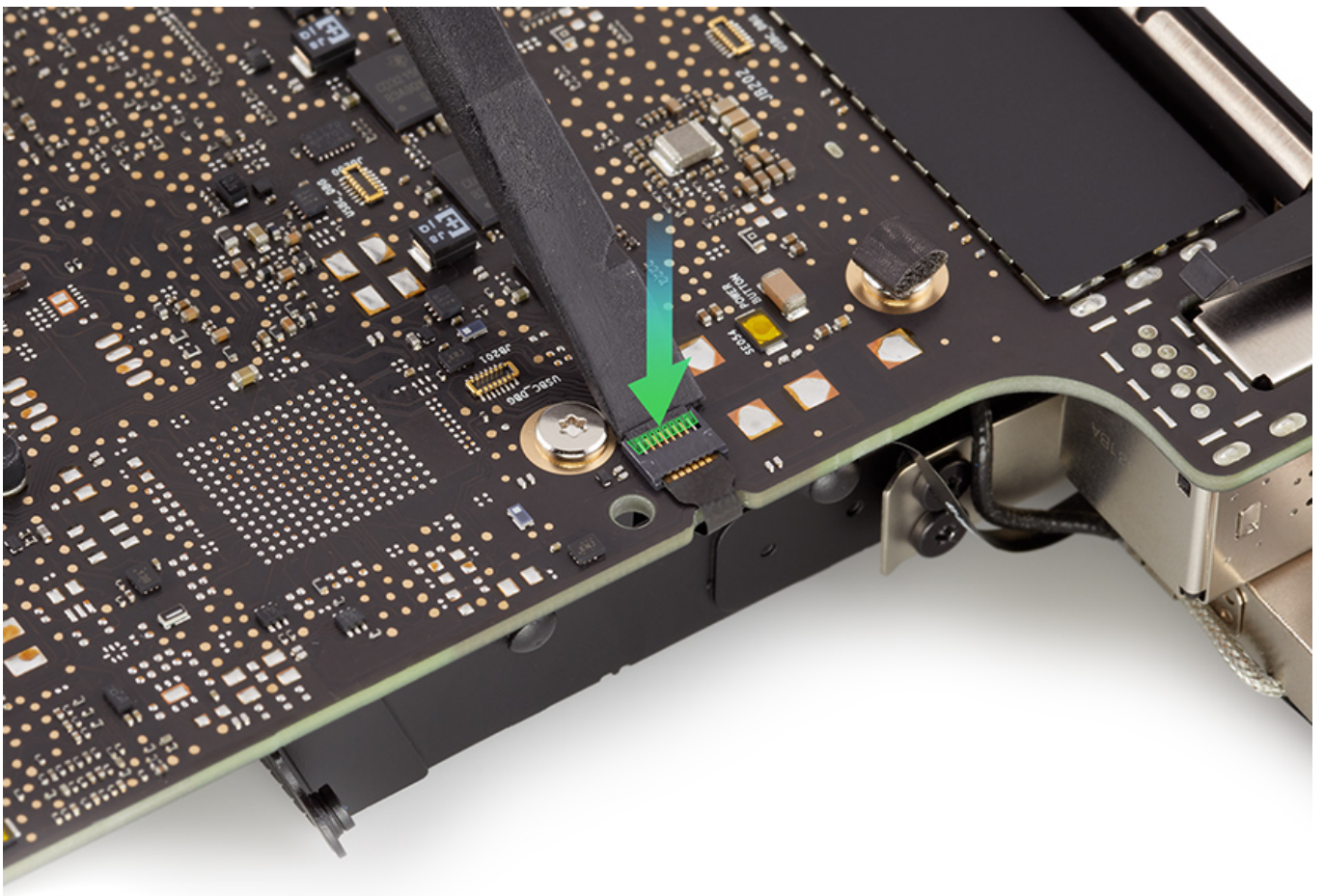
9. Rotate the logic board to access the power button flex cable. Press down with the flat end of a black stick to adhere the power button cable to the logic board.



10. Turn over the logic board and reconnect the power button flex cable.



11. Press down on the locking lever to secure the cable.



12. Reinstall the [speaker](#).

13. Reinstall the [logic board](#).

14. Reinstall the [fan](#).
15. Reinstall the [antenna plate](#).
16. Reinstall the [bottom cover](#).

Mac mini (2018) Housing

First Steps

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Cover](#)
- [Antenna Plate](#)
- [Fan](#)
- [Logic Board](#)
- [Power Supply](#)



Tools

- No tools required

Steps For Removal

Cosmetic Care: Cosmetic surfaces have a high exposure to potential damage or scratching. Be careful not to damage the housing and other cosmetic surfaces with inadvertent tool movements. As a precaution, apply painter's tape around the housing edges, especially when handling the antenna plate. In general, avoid scratching interior or exterior surfaces.

When all other parts have been removed, the housing is the remaining part.

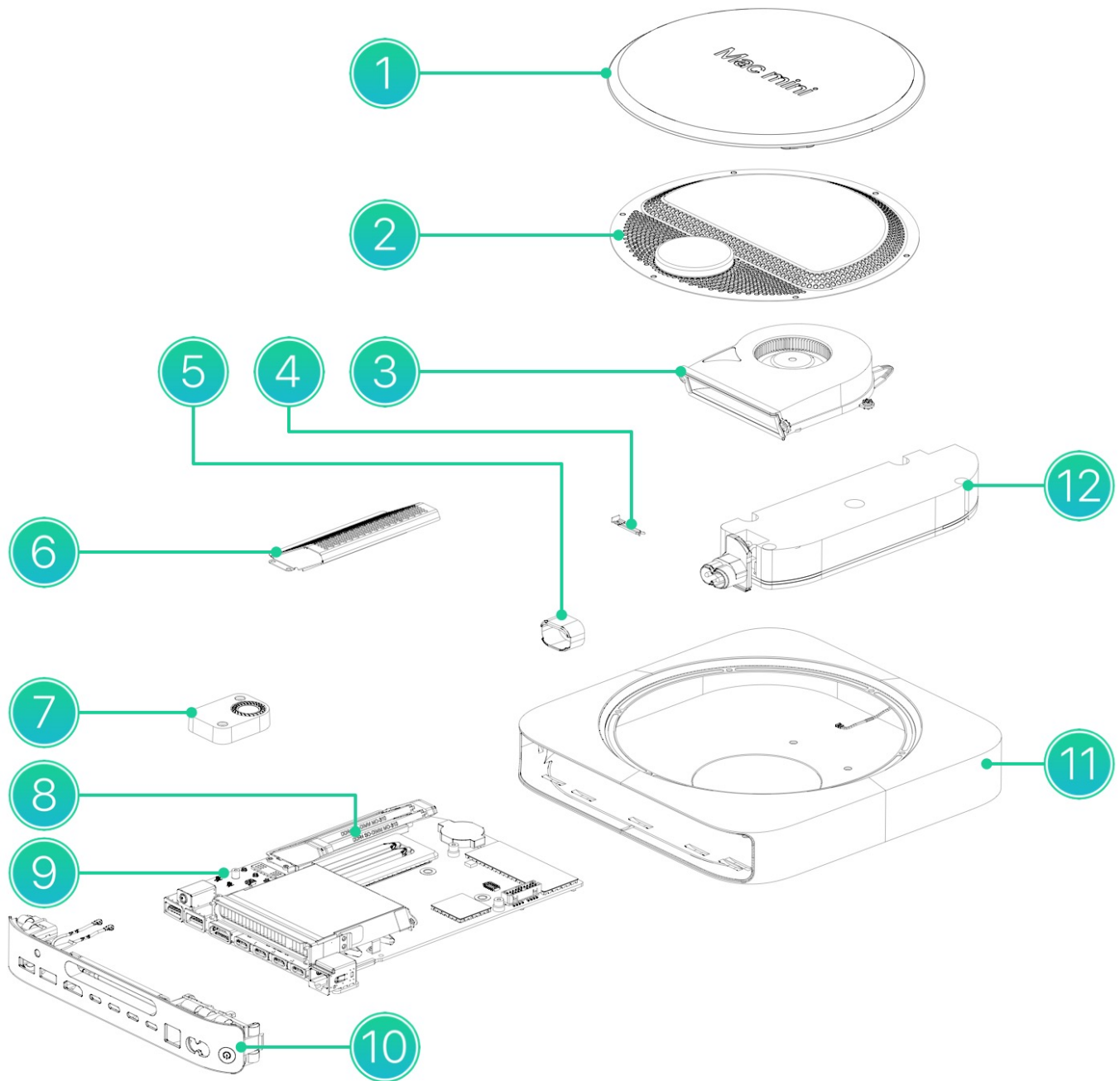
- The status indicator light (SIL) is included with the housing.

Steps For Reassembly

1. Reinstall the [power supply](#).
2. Reinstall the [logic board](#).
3. Reinstall the [fan](#).
4. Reinstall the [antenna plate](#).
5. Reinstall the [bottom cover](#).

Mac mini (2018) Exploded View

Mac mini (2018) Exploded View



1. Bottom Cover

- 923-02436

2. Antenna Plate

- 923-02437

3. Fan

- 923-02434

4. AC Inlet Retention Clip

- 923-02789

5. AC Inlet Cowling

- 923-02795

6. Memory Cover (includes left and right bumpers)

- 923-02794, (cover with left and right bumpers)
- 923-02792, (left and right bumpers)

7. Speaker

- 923-02435

8. Memory

- 661-10239, 4GB, DDR4, 2666MHz
- 661-10240, 8GB, DDR4, 2666MHz
- 661-10241, 16GB, DDR4, 2666MHz
- 661-10242, 32GB, DDR4, 2666MHz

9. Logic Board

- 661-10205, 3.0GHz i5, 256GB, 1Gb ENET
- 661-10206, 3.0GHz i5, 256GB, 10Gb ENET
- 661-10207, 3.0GHz i5, 512GB, 1Gb ENET
- 661-10208, 3.0GHz i5, 512GB, 10Gb ENET
- 661-10209, 3.0GHz i5, 1TB, 1Gb ENET
- 661-10210, 3.0GHz i5, 1TB, 10Gb ENET
- 661-10211, 3.0GHz i5, 2TB, 1Gb ENET
- 661-10212, 3.0GHz i5, 2TB, 10Gb ENET
- 661-10213, 3.2GHz i7, 128GB, 1Gb ENET
- 661-10214, 3.2GHz i7, 128GB, 10Gb ENET
- 661-10215, 3.2GHz i7, 256GB, 1Gb ENET
- 661-10216, 3.2GHz i7, 256GB, 10Gb ENET
- 661-10217, 3.2GHz i7, 512GB, 1Gb ENET
- 661-10218, 3.2GHz i7, 512GB, 10Gb ENET
- 661-10219, 3.2GHz i7, 1TB, 1Gb ENET
- 661-10220, 3.2GHz i7, 1TB, 10Gb ENET
- 661-10221, 3.2GHz i7, 2TB, 1Gb ENET
- 661-10222, 3.2GHz i7, 2TB, 10Gb ENET
- 661-10223, 3.6GHz i3, 128GB, 1Gb ENET
- 661-10224, 3.6GHz i3, 128GB, 10Gb ENET
- 661-10225, 3.6GHz i3, 256GB, 1Gb ENET
- 661-10226, 3.6GHz i3, 256GB, 10Gb ENET
- 661-10227, 3.6GHz i3, 512GB, 1Gb ENET
- 661-10228, 3.6GHz i3, 512GB, 10Gb ENET
- 661-10229, 3.6GHz i3, 1TB, 1Gb ENET
- 661-10230, 3.6GHz i3, 1TB, 10Gb ENET
- 661-10231, 3.6GHz i3, 2TB, 1Gb ENET
- 661-10232, 3.6GHz i3, 2TB, 10Gb ENET

10. I/O Wall

- 923-02788

11. Housing

- 923-02790

12. Power Supply

- 661-09983

Tools and Fixtures

- See article [OP101: Required Tools](#).

Mac mini (2018) Screw Chart

Mac mini (2018) Screw Chart

<p>923-00155 T6 security</p>  <p>Antenna plate (3)</p> <p>Note: Screw must be tightened to a torque value of 0.3 Nm.</p>	<p>923-00157 T6 security</p>  <p>Antenna plate (3)</p> <p>Note: Screw must be tightened to a torque value of 0.3 Nm.</p>	<p>923-00230 T6</p>  <p>I/O wall to logic board (1)</p> <p>Note: Captive washer included.</p>
<p>923-02796 T6</p>  <p>Power Supply (3)</p>	<p>923-02798 T6</p>  <p>Memory Cover (4)</p>	<p>923-02800 T6</p>  <p>I/O wall to heat sink (4)</p>
<p>923-02801 T6</p>  <p>Speaker (2)</p>	<p>923-02802 T10</p>  <p>Logic Board (2)</p> <p>Note: Screw must be tightened to a torque value of 1.2 Nm.</p>	<p>923-02803 T6</p>  <p>Fan (4)</p>
<p>923-03034 T6</p>  <p>Antenna Cable Ground Screw Antenna Plate (1)</p> <p>Note: Captive washer included.</p>		

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